Prediction of psychosocial problems in adolescents

Jaspers, Merlijne

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Do early childhood findings from routine preventive child healthcare help?

Merlijne Jaspers

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PREDICTION OF PSYCHOSOCIAL PROBLEMS IN ADOLESCENTS

Do early childhood findings from routine preventive child healthcare help?

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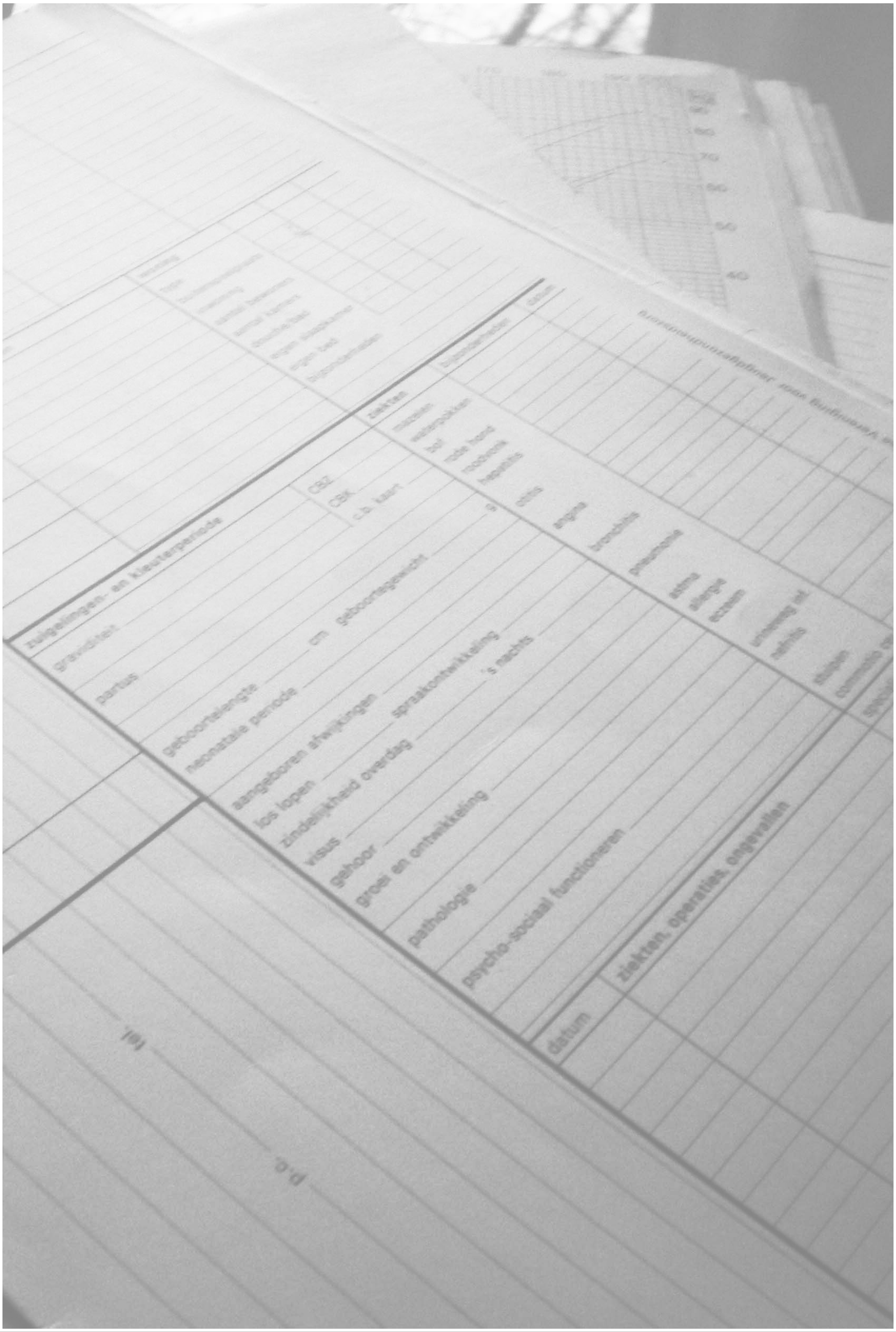
Promotor:	Prof. dr. S.A. Reijneveld
Copromotor:	Dr. A.F. de Winter
Beoordelingscommissie:	Prof. dr. F.J.M. Feron
	Prof. dr. E.J. Knorth
	Prof. dr. A.J. Oldehinkel

Paranimfen:	Andrea Sudara Fokkens
	Jelle David Jaspers

CONTENTS

List of abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
AUC	Area Under the Curve
BIC	Bayesian Information Criterion
CBCL	Child Behavior Checklist
CI	Confidence Interval
CSBQ	Children's Social Behavior Questionnaire
LC	Latent Class
MNL	Multinomial Logistic regression
OR	Odds Ratio
PCH	Preventive Child Healthcare
SES	Social Economic Status
TRAILS	Tracking Adolescents' Individual Lives Survey
YSR	Youth Self Report



1

General Introduction

Introduction

Three-year-old Alex is scheduled for a regular Preventive Child Healthcare (PCH) assessment. Today he is seen by Ina Janssen, a PCH professional, who has seen him several times since he is born. Alex lives with his mother; he cries and clings to her when they enter Ina's office. During the 15 minutes interview and assessment Alex continues to cry. Mother has several concerns about his behavior; at home Alex cannot play alone, his mother needs to help or stimulate him into his play. When mother is doing other things in the house he starts to whine. He only wants to eat when mother feeds him. Ina Janssen wonders if Alex needs more monitoring to follow his development because his behavior stands out compared to other children. In the PCH file there are only a few remarks, it is documented that mother smoked during her pregnancy, that father left when Alex was one year old and that Alex had a delay in his motor development in the first year.

Bert Bakker, another PCH professional, sees fourteen-year-old Tessa and her mother. Tessa's mother is concerned about Tessa because as she puts it: Tessa is very boisterous, disobedient and she rants and raves. Her behavior can spoil the mood of all family members. Bert notices that Tessa is described as highly impulsive and disobedient many times in the PCH file, but there are no other special remarks in the PCH file concerning the previous years. The behavior of Tessa has not been a problem for her mother in the past, but the last three months she cannot put up with it anymore, especially now that Tessa has been arrested for shoplifting. Tessa agrees that things have gone from bad to worse and would like to try to change a bit, but says she doesn't know how. Bert gives Tessa and her mother advice on her behavior and makes a new appointment for them in three months. Bert Bakker wonders if anything could have been done on Tessa's problems earlier on.

These two cases are good examples of what PCH professionals encounter during their job. It is important for professionals to base their assessments and decisions on the best available knowledge. Therefore, more knowledge on the early predictors for psychosocial problems from data of the PCH is relevant because this might improve the prevention and management in PCH.

The aim of this thesis was to investigate whether early findings of PCH professionals predict psychosocial problems in adolescents. In this chapter the key concepts and the broader context of this thesis are introduced. At the end of this chapter the research questions, the methodology of the study and outline of this thesis will be presented.

Psychosocial problems

In this thesis psychosocial problems are defined as problems in psychosocial functioning of the child, they may be emotional but are often also visible in the child's behavior, following Dutch PCH guidelines.[1,2] Children can experience these problems to varying degrees. One of the main aims of the PCH is (early) detection of problems in order to offer effective care to these children as soon as possible.

Psychosocial problems comprise a number of problems, important ones being: internalizing[a], externalizing[b], attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) problems. In childhood and adolescence the two broadband categories internalizing and externalizing problems are the most frequent.[3,4] Internalizing problems are problems that cause mainly internal distress, such as anxiety, depression and (psycho)somatic complaints. Externalizing problems are problems that mainly result in conflict with others, such as aggressive and delinquent behavior. Other psychosocial problems are the neurodevelopmental behavior problems: ADHD and ASD problems. Key characteristics of ADHD problems are hyperactivity, inattention and impulsivity. Core symptoms of ASD problems are a lack of social interest, problems with social understanding, stereotyped behavior, and resistance to change.

Worldwide, estimates of prevalence rates for an internalizing disorder range from 4.6% to 8.6% for children and adolescents and between 5.7% and 10.3% for an externalizing disorder.[3] Up to twice as many have functional problems related to internalizing or externalizing problems but do not meet criteria for diagnosis.[5] A recent study shows a prevalence rate of 14.7% for internalizing problems for children and adolescents and of 16.2% for externalizing problems.[6] Co-occurrence can be up to 56%.[7] For ADHD and ASD prevalences range between 6-9%[8-12] and between 0.4% and 1% respectively.[13-16] 30–80% of ASD children meet the criteria for ADHD.[15,17] Recently the field has broadened its focus so that it now views ASD and ADHD as constituting the very severe end of continuous distributions in the general population.[18-21] Prevalence rates of (functional problems related to) ASD and ADHD problems are not (yet) available.

Prevalence rates differ among boys and girls per (type of) psychosocial problem.[3] Age of onset of psychosocial problems varies per specific problem, but substantial evidence suggests that some psychosocial problems may onset in early to middle childhood.[22-26] The above mentioned problems of children and adolescents are a major burden for children, their parents and others in the environment because they severely interfere with everyday functioning of children and their families.

Screening & early detection

Psychosocial problems are common in children. Prevalence rates of psychosocial problems in children, adolescents and adults suggest high persistence from childhood to adulthood and/or high levels of recurrence.[27-31] Wilson and Jungner defined screening criteria in 1968 to guide the selection on conditions that would be suitable for screening, based on the capacity to detect the condition at an early stage and the availability of an acceptable treatment.[32] Research has shown that early identification of psychosocial problems, if followed by adequate intervention, may improve prognosis.[33,34] It seems important to identify, monitor

[a] In this thesis, internalizing problems and emotional problems are synonymous.
[b] In this thesis, externalizing problems and behavioral problems are synonymous.

and, if necessary, intervene in these psychosocial problems as early as possible. PCH services offering routine healthcare to the young population as a whole are in a unique position for early identification of psychosocial problems in children.

As Brugman et al.[35] concluded in 2001, screening for psychosocial problems in school aged children is a promising option to reduce these problems. Reijneveld et al.[36] came to a similar conclusion for preschool children; there is substantial room for improving the early identification of psychosocial problems. Wissow[37] stated that the mental health promotion potential of pediatrics primary care is not being fulfilled. Studies in the US and UK suggest that pediatricians and general practitioners identify only one quarter of children and adolescents with mental health problems.[38,39]

PCH setting

In the Netherlands and abroad, the PCH services offer an ideal setting for the early detection of psychosocial problems. By seeing so many children, hearing signals and getting questions from children, parents and teachers, they are often the first to see indications of these problems. The Dutch PCH provides health and developmental monitoring for all children from birth until age 19, and the participation rate is over 90%. Among the main tasks is the identification of children with psychosocial problems. The Dutch PCH is transitioning from an organization that was primarily focused on immunization and physical development (in the 1950s) to an evidence based healthcare service where psychosocial development of children is just as important, and where the focus is more on high risk groups and more personalized.

Monitoring is done through semi-structured interviews with parents, general physical examinations and standardized screening procedures, all of which are documented in a PCH file. The PCH has a variety of disciplines working in their services; from specialized community and youth doctors and nurses to dieticians, speech therapists, epidemiologists, and sometimes psychologists. An assessment generally takes approximately 10 to 15 minutes. Up to the age of 4 years children are seen with their parents by a PCH professional, at specific intervals, 15 times as part of the routine procedure of the PCH (at well-baby clinics). During primary and secondary school children are seen three times. Next to these standardized visits children, parents, teachers or PCH professionals can also request an extra visit (for more information on the Dutch PCH system see Vogels[40]). In this thesis data from the well-baby clinics and the PCH assessment in early school age are used.

PCH professionals monitor the development of children and identify many problems but how predictive are these early findings? We actually have little knowledge on what the predictive validity of these early findings is.

Outline of the thesis

The following research questions will be answered in this thesis.

1. Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH?
2. Which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting?
3. Can we identify early indicators of autism spectrum disorder and attention deficit hyperactivity disorder problems with early childhood findings as registered by PCH?
4. Can we predict which children have a heightened chance of being disliked or ignored by their preadolescent peers with data from the routine PCH?
5. How is the validity of parental recall on pregnancy, birth and early childhood behavior in preadolescence?

In Chapter 2 a prediction model is developed and validated for psychosocial problems in preadolescence using data on early developmental factors. Chapter 3 describes trajectories of internalizing and externalizing problems in adolescents and identifies early indicators of these trajectories among boys and girls. Chapter 4 identifies early indicators of ASD and ADHD problems in adolescents. Chapter 5 focuses on early childhood indicators for being disliked or ignored by peers in preadolescence. Chapter 6 examines the validity and precision of parental recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior. Many previous studies on early risk factors for psychosocial problems relied on retrospectively collected data and included a limited number of risk factors. The validity of data collected retrospectively needs to be examined before using them to estimate relationships with health or developmental outcomes. Finally, in Chapter 7 the main findings and conclusions of the previous chapters are presented and discussed.

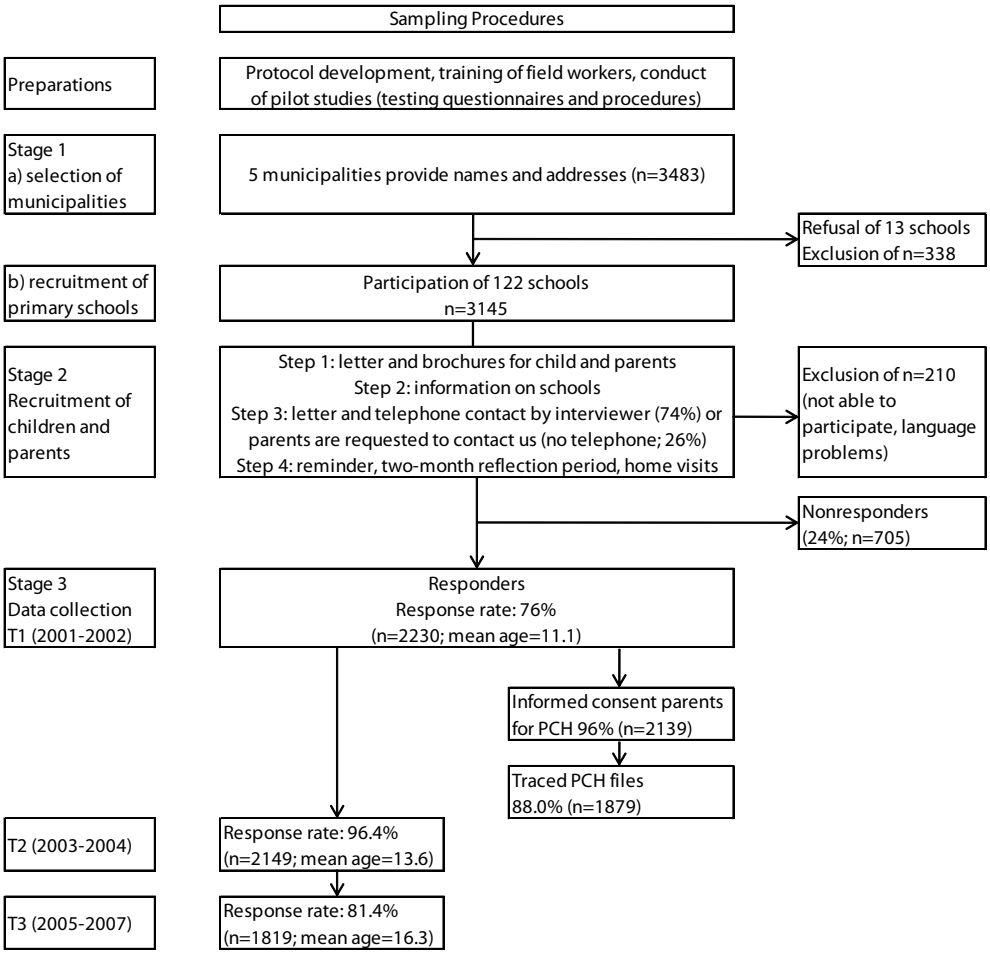
The study sample

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch children starting at 10-12 years of age that focuses on adolescent psychosocial development and mental health in the general population.[41] The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities –Assen, Dantumadeel, Groningen, Leeuwarden and Winschoten- to obtain a representative sample of the three northern provinces of the Netherlands, also see Figure 1. Out of all the children approached for enrolment in the study (n=3145) 6.7% were excluded because of mental or physical incapability or language problems. Seventy-six percent of the remaining 2935 children (n=2230, mean age=11.1, SD=0.6, 50.8% girls) and their parents agreed to participate. Written informed consent was obtained from parents or custodians. Responders and non-responders did not differ with respect to the prevalence of teacher-rated problem behavior nor in regard to associations between sociodemographic variables and mental health

outcomes.[42] Data collection occurred by parent, child and teacher completed questionnaires and a home-visit by trained interviewers. The first, second (n=2149, mean age=13.6, SD=0.5) and third wave (n=1819, mean age=16.3, SD=0.7) ran, respectively, from March 2001 to July 2002 (T1), from September 2003 to December 2004 (T2), and from September 2005 to December 2007 (T3). Furthermore, participants were asked for permission to retrieve the child's file from the PCH. All procedures were approved by the Dutch Central Committee on Research Involving Human Subjects ("CCMO").

Data were used from the first, second and third wave if data from the PCH files were available (see Figure 1). Written informed consent was given by 2139 (96%) parents to retrieve their child's file from the PCH archives. Out of these, 84.9% could be traced for well-baby files (n=1816 PCH files, mean age=11.1, SD=0.5, 50.9% girls) and 57.6% school PCH

Figure 1. Study population



files (n=1233 files, 52% girls). The most common reason for non-retrieval of the PCH file comprised children moving into the research area shortly before inclusion in the TRAILS cohort. Children with and without a PCH file differed in parent-rated ASD (M=5.45, SE=0.13 for the retrieved and M=7.25, SE=0.36 for the non-retrieved, $p<0.001$) and ADHD problems (M=3.83, SE=0.08 vs. M=4.41, SE=0.19, respectively, $p<0.01$) at T1. The number of individuals that were included in the analyses differs for the separate chapters of this thesis, depending on the availability of (complete) data on the measures that were used in the different analyses.

From these PCH files (well-baby and school files) we collected data on pre- and perinatal variables, early physical and psychosocial development and sociodemographic variables (see Box 1). A PCH professional checks these items during consultations of the child at the well-baby clinic or at school. They are checked for children between the ages of zero to 6 years. The professional recorded whether the child's sleeping and eating behavior was normal or abnormal, as was reported by the parent. The professional recorded what kind of behavior(s) the child had, as was reported by the parent or as was judged from observation. Because of the 'complexity/richness' of the data, i.e. the different time measurements both in the PCH files and of the questionnaires, we use different operationalizations for the different chapters.

Box 1. Overview of collected data from PCH files

- Maternal smoking during pregnancy
- Maternal alcohol use during pregnancy
- Gestational age
- Birth weight (in grams)
- Birth defects
- Head circumference (age 0-12 mos.)
- Weight (age 0- 4 yrs.)
- Height (age 0- 4 yrs.)
- Psychomotor development with the Van Wiechen Scheme (age 1-15 mos.)
- Motor development (age 1.5- 4 yrs.)
- Language and speech development (age 1.5- 4 yrs.)
- Neurological problems (age 0- 4 yrs.)
- Problems/difficulties with sleeping (age 1.5- 6 yrs.)
- Problems with eating (age 1.5- 6 yrs.)
- Behavior of children (see Table 1 in Chapter 2 for all descriptions) (age 1.5- 6 yrs.)
- Enuresis (age 4 yrs.)
- Educational level of parents
- Structural family characteristics: i.e. living with both biological parents, divorced parents, stepparent(s), or single-parent households.

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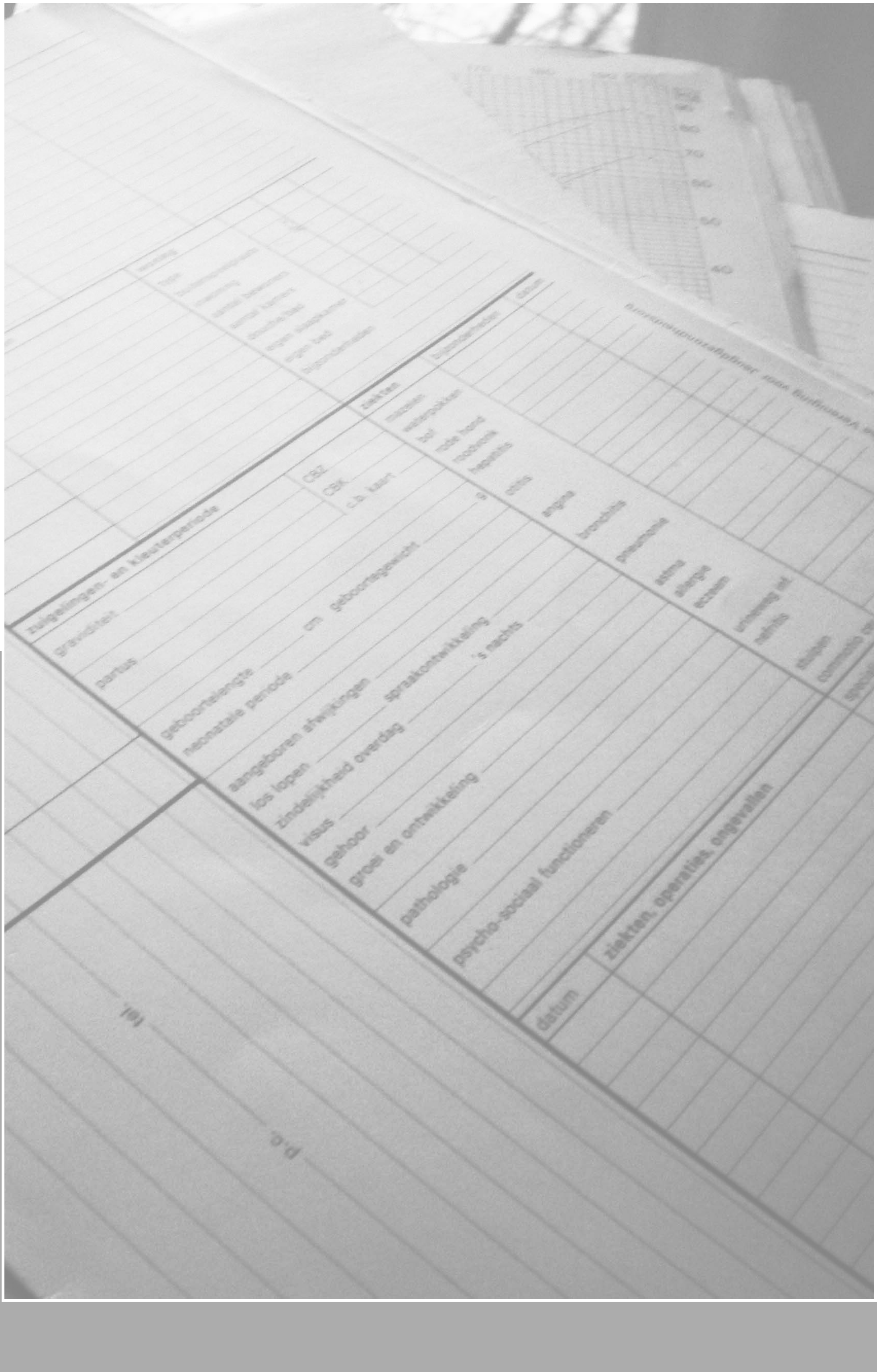
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allergie
eczeem

2

Early findings of Preventive Child Healthcare professionals predict psychosocial problems in preadolescence

M. Jaspers
A.F. de Winter
G. de Meer
R.E. Stewart
F.C. Verhulst
J. Ormel
S.A. Reijneveld

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Abstract

Objective

The aim of this study is to develop and validate a prediction model for psychosocial problems in preadolescence using data on early developmental factors from routine Preventive Child Healthcare (PCH).

Study design

The data comes from the 1692 participants who take part in TRAILS, a longitudinal study. Information on early developmental factors (ages 0 to 4 years) was collected from the PCH file. Parents complete the Child Behavior Checklist (CBCL) at age 11. To examine the predictive value of PCH-registered developmental factors on preadolescent problems, several multiple logistic regression analysis were performed, in a derivation sample (n=1058). The predictive performance of the models was then assessed with Area Under the Curve (AUC) in a validation sample (n=643) to evaluate the validity of these models.

Results

PCH-registered behavioral problems, attention hyperactivity problems, enuresis, level of education of the father, and being male were found to significantly predict externalizing problems (odds ratios (OR) between 1.4 and 3.7). Internalizing problems were predicted by maternal smoking during pregnancy, sleep problems and being male (ORs between 1.7 and 3.0). The model for externalizing problems had a modest discriminatory power (AUC 0.66, 95% CI 0.59-0.72). However, for internalizing problems the AUC was 0.54 (95% CI 0.47-0.60), indicating poor discriminatory power.

Conclusions

Findings on early development as registered by PCH are modestly predictive for externalizing problems in preadolescents, but only slightly for internalizing problems.

Introduction

The psychosocial (emotional and behavioral) problems of children and adolescents are a major burden for children, their parents and others in the environment. There is now substantial evidence that some psychosocial problems have an early age of onset, coupled with high levels of recurrence over the course of life.[1-4] The period from conception until school age is considered extremely important for children's development and especially their socio-emotional development, which affects psychosocial functioning later in life.[5,6] Consequently, early detection and treatment of psychosocial problems may considerably improve prognosis. Several reviews have emphasized the need for early detection and subsequent adequate treatment in order to prevent later negative health effects.[7-9] However, early detection of psychosocial problems is complex.

Community pediatric services that offer routine healthcare services to the young population as a whole, such as those in the USA and Europe, occupy a unique position in terms of early detection of psychosocial problems in children. In the Netherlands, Preventive Child Healthcare (PCH) provides health and developmental monitoring to all Dutch children from birth until age 19, and the participation rate is over 90%.[10] Dutch PCH professionals are fully committed to well-child visits, and are highly trained and experienced in registering those child and family characteristics that are relevant for current and future development. Identification of children with psychosocial problems is one of the explicit tasks of PCH, along with checking a wide range of factors as part of its routine health monitoring.

The literature shows that the detection of psychosocial problems in children is less than satisfactory, with many early psychosocial problems going undetected.[10,11] To assess the validity of early detection, a good standard to use is the occurrence of problems later in life. One of these is the development of future psychosocial problems. To distinguish healthy development from the development of psychosocial problems in children, longitudinal data are necessary to arrive at valid predictions. The aim of this study is to develop and validate a prediction model for psychosocial problems in preadolescence using data on early developmental factors found in routine Preventive Child Healthcare (PCH). This study is the first to use routine data from PCH to predict psychosocial problems in children in a community-based sample.

Methods

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch children from 10-12 years of age that focuses on adolescent psychosocial development and mental health.[12] The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities in the northern part of the Netherlands.[12,13] Out of all the children approached for enrolment in the study (n=3145), 6.7% were excluded because of mental or physical incapability or language problems. Of the remaining 2935 children, both children and parents of 76.0% (n=2230, mean age=11.09, SD=0.56, 50.8% girls) of them

agreed to participate. Responders and non-responders did not differ with respect to the prevalence of teacher-rated problem behavior, nor in terms of associations between socio-demographic variables and mental health outcomes.[13]

Written informed consent was given by 2139 (96%) parents to retrieve their child's file from the PCH. Out of these, 84.9% could be traced (n=1816 PCH files, mean age=11.06, SD=0.54, 50.9% girls). Children with and without a PCH file differed with statistical significance for prevalence of parent-rated behavior problems (14.4% for the retrieved vs. 20.0% for the non-retrieved, $p<0.05$) but did not differ with statistical significance with respect to the prevalence of parent-rated emotional problems (16.6% vs. 18.2%, respectively). This study was approved by the national ethical medical committee.

Measures

Information on predictors had previously been collected by community physicians and nurses (PCH professionals) as part of the routine procedure of PCH. The assessments included a general physical examination, standardized screening procedures and a semi-structured interview with parents concerning health status and physical, emotional and behavioral developmental problems, all of which were documented in the PCH file. An assessment generally takes approximately 10 to 15 minutes. As potential predictors, we selected prenatal and perinatal factors, early childhood behaviors and socio-demographic variables from the PCH file.

Prenatal and perinatal variables

The prenatal and perinatal variables in the PCH files concerned maternal smoking during pregnancy and low birth weight (registered in grams) as provided by the obstetrician or midwife. Maternal smoking was assessed as: "Did the mother smoke during pregnancy?" dichotomized as always/never. Low birth weight was operationalized as < 2500 grams, which is a standard clinical cut-off.[14]

Early childhood problems

Early childhood problems entailed PCH-registered behavioral features at age four (mean age=3.88 years, SD=0.15), from which we distinguished "sleeping, eating and enuresis problems" and "emotional and behavior problems." During PCH visits, the PCH professional inquired into these problems with questions such as: "How is your child doing in terms of eating?", "How is your child doing in terms of sleeping?" and "How is your child doing in terms of toilet-training?" Descriptions of these behaviors were categorized as "yes" in case of problems, and "no" or "missing." "Emotional and behavior problems" were collected from two open questions in the PCH files, namely, "How is the child's behavior?" and "How is the child's social behavior?" about which parents could provide one or more descriptions such as "overactive," "shy," "anxious," "social" or "aggressive" (see Table 1). Eight PCH professionals

independently categorized the PCH-registered descriptions – emotional, behavioral, attention hyperactivity problems or positive social behavior – in terms of "yes," "no" or "not applicable." A PCH item could not be placed in more than one category by the PCH professionals. PCH professionals shared a very high consensus about the classification of the descriptions. The PCH descriptions were dichotomized as a "yes" if any of these were present and as a "no" if none were present.

Socio-demographic variables

The socio-demographic variables were the highest educational level of the father and highest educational level of the mother. We distinguished three groups: low (lower tracks of secondary education or less education), middle (higher tracks of secondary education) and high (university degree or more) educational levels, respectively.

Behavioral and emotional problems

Behavioral and emotional problems at age 10-12 were assessed using the parent-completed Child Behavior Checklist (CBCL) for ages 4-18, an internationally validated questionnaire for child emotional and behavioral problems.[15,16] In the current study we used two broadband scales: externalizing and internalizing problems. Externalizing problems consist of the aggressive behavior and delinquent behavior syndrome scales. Internalizing problems consist of the anxious/depressed, somatic complaints and withdrawn/depressed syndrome scales. Cases were allocated to a normal score or a clinical (elevated) score, using the age and gender-specific 90th percentiles of the Dutch normative sample.[15,16]

Analyses

An average of 8.8% (ranging from 1.2 to 20.3%) of the values of the potential predictors was missing. Missing data on potential predictors were labeled as a separate "unknown" category in the analysis. This was done to explore whether the missing values were missing at random in the PCH files, or not. For the CBCL outcome measures, the number of missing data was quite low, ranging from 0 through 31, with a median of 3.0. Missing data on the CBCL were imputed with individual means by the corrected item mean imputation (CIM) using SPSS version 14. Analyses were restricted to those for whom PCH data as well as parent-reported psychosocial problems were available (n=1692).

First, descriptive statistics were calculated for general characteristics, developmental factors and for the outcome measures. We needed two data sets for our derivation and cross-validation analyses, with both sets large enough for sufficient statistical power. Since a minimum of 100 events and 100 nonevents is recommended for external validation samples,[17] and Peduzzi[18] states that ideally there should be at least 10 cases per candidate predictor, we randomly divided the total sample into two unequal subsamples. The derivation sample (approximately two thirds of the children, n=1058) was used to build a

Table 1. Description of behavior of children by PCH professionals divided into four categories by PCH professionals

Behavioral problems	Emotional problems	Attention hyperactivity problems	Positive behavior
Aggressive	Anxious	Boisterous	Affectionate
Argues a lot	Clings to mother	Concentration problems	Attentive
Argumentative	Cries easily	Difficulty concentrating during play	Cheerful
Bold	Easily frightened	Distracted/hyperactive	Confident
Bites others	Fear of failure	Dreamy	Cooperative
Behavioral problems	Fear of abandonment	Easily bored	Cool, composed
Defiant	Insecure	Impulsive	Cuddly
Demands attention in	Introvert	Jumps from one thing to another	Curious
a negative way	Nervous	Noisy	Cute
Disobedient	Over-sensitive	Pushes the limits	Eager to learn
Throws toys	Over-submissive	Reacts to everything and everyone	Easy
Gets "beside him/herself"	Panics easily	Restless	Enthusiastic
Harassing	Quiet	Sees no danger	Flexible
Headstrong	Separation anxiety	Talks excessively	Focused
Hits others	Silent	Turbulent	Helpful
Impatient	Shy	Very active	Independent
Impertinent	Timid	Volatile	Interested
Imposing	Worried	Wild	Kind
Kicks others		Short attention span	Lively
Manipulative			Looks after others
Moody			Nice
Nagging			Open
Oppositional			Patient
Overly present			Picks up on things easily
Provocative			Polite
Quickly becomes angry			Rich imagination
Rebellious			Social
Stubborn			Sociable
Temper tantrums			Spontaneous
Whining			Sweet

predictive model. The validation sample (n=634) was used for evaluation of the validity of the model. Statistical analyses were performed using SPSS version 14.

Second, to examine the influence of early development on the clinical scores of the broadband scales of the CBCL, logistic regression analyses were performed. Based on the results of the univariate analyses, we considered variables associated with the outcomes at $p<0.2$ to be candidates for multiple logistic regression analyses for both outcome measures. The variables were entered into a backward stepwise logistic regression procedure, generating a subset of independent predictors for different scales of the CBCL. Interaction terms were also tested as candidate variables in logistic regression; however, none of these terms fulfilled the entering criteria.

Third, the accuracy of the logistic model (the combined set of predictors from the multivariate analyses) in discriminating children with and without clinical CBCL scores in the derivation set was evaluated by calculating the Area Under the receiver operating characteristic Curve (AUC). The AUC is a measure of the diagnostic power of a test that summarizes the likelihood of a dichotomized outcome (i.e., a clinical CBCL score) at various cut-offs of a test, in this case a prediction. The AUC can range from 0.50 (no discrimination) to 1.0 (perfect discrimination). Values of 0.50 to 0.60 are considered poor, 0.61 to 0.70 as moderate, 0.71 to 0.80 as good, and 0.81 to 0.90 as excellent.[19,20] Furthermore, by relating them to the predicted probability from the logistic model, sensitivity and specificity for the outcome measures were calculated for a number of cut-off points.

Results

The descriptive statistics for general characteristics, predictor variables and outcome measures are presented in Table 2. There were no statistically significant differences between the derivation and validation sets.

Table 3 gives the crude and multivariate odds ratios and 95% confidence intervals on predictors of externalizing and internalizing clinical scores on the CBCL. Within the derivation set, behavioral problems, attention hyperactivity problems, enuresis (all at age 4), low level of education of the father, and being male were identified as significant independent determinants of clinical externalizing problems on the CBCL (OR between 1.6 and 2.3) in the multivariate logistic regression model. Level of education of the father and eating problems did not contribute to the model as independent predictors. For clinical internalizing problems on the CBCL, sleep problems (at age 4), maternal smoking during pregnancy, being male, and unknown status of enuresis were determinants (OR between 1.6 and 3.0). The label "unknown" on the different factors was predictive for later externalizing and internalizing problems (OR between 1.6 and 2.4).

The AUC for externalizing problems was 0.68 (95% CI 0.64-0.73) for the derivation set (Figure 1A). When applied to the validation set, the model discriminated between children with a clinical score and those with no clinical score on the CBCL with an AUC of 0.66 (95% CI

0.59-0.72). In terms of specificity and sensitivity this means that at 90% specificity the corresponding sensitivity was 27% (see Table 4). For internalizing problems on the CBCL, the AUC was 0.63 (95% CI 0.59-0.68) for the derivation set and 0.54 (95% CI 0.47-0.60) for the validation set (Figure 1B). With a specificity of 90%, sensitivity was 16%.

Table 2. General characteristics of the derivation set and the validation set

Variables	Derivation set (n = 1058)	Validation set (n = 634)
Age at TRAILS T1 (Mean, SD)	11.06 (0.54)	11.06 (0.52)
Boys (n, %)	505 (47.7)	318 (50.2)
Low education of mother (n, %)	367 (34.7)	228 (36.0)
Low education of father (n, %)	301 (28.4)	170 (26.8)
Maternal smoking during pregnancy (n, %)	142 (13.4)	84 (13.2)
Low birth weight (n, %)	39 (3.7)	27 (4.3)
Sleep problems (n, %)	31 (2.9)	18 (2.8)
Problems with eating (n, %)	206 (19.5)	125 (19.7)
Enuresis (n, %)	180 (17.0)	130 (20.5)
Behavioral problems (n, %)	55 (5.2)	31 (4.9)
Emotional problems (n, %)	46 (4.3)	26 (4.1)
Attention hyperactivity problems (n, %)	105 (9.9)	78 (12.3)
Positive social behavior (n, %)	299 (28.3)	152 (24.0)
Outcome measures		
Externalizing problems (n, %)	160 (15.1)	85 (13.4)
Internalizing problems (n, %)	190 (18.0)	110 (17.4)

Table 3. Associations of early developmental features with clinical scores on externalizing and internalizing problems: odds ratios and 95% confidence intervals (CI)

		Externalizing		Internalizing	
		OR (crude) 95% CI	OR (adj*) 95% CI	OR (crude) 95% CI	OR (adj) 95% CI
Being male		**2.1 (1.5-3.0)**	2.0 (1.4-2.8)	**2.0 (1.4-2.8)**	2.0 (1.5-2.9)
Maternal smoking during pregnancy		**1.8 (1.1-3.1)**		**1.6 (1.0-2.6)**	1.7 (1.1-2.6)
Low birth weight		0.6 (0.2-1.8)		1.0 (0.4-2.2)	
Low education of mother		**2.1 (1.3-3.2)**		1.1 (0.8-1.7)	
Middle education of mother		**1.2 (0.8-2.0)**		0.9 (0.6-1.4)	
Low education of father		**2.1 (1.3-3.3)**	2.0 (1.2-3.2)	0.9 (0.6-1.4)	
Middle education of father		**1.6 (1.0-2.5)**		1.1 (0.7-1.7)	
Sleep problems		**2.1 (0.9-4.7)**		**3.0 (1.4-6.2)**	3.0 (1.4-6.3)
Problems with eating		**1.6 (1.1-2.4)**		**1.3 (0.9-1.9)**	
Enuresis		**1.9 (1.2-2.8)**	1.6 (1.1-2.5)	**1.0 (0.6-1.6)**	
Positive social behavior		1.1 (0.8-1.6)		**0.7 (0.5-1.0)**	
Behavioral problems		**3.0 (1.6-5.3)**	2.3 (1.2-4.2)	**1.9 (1.1-3.6)**	
Emotional problems		0.5 (0.2-1.5)		1.5 (0.7-2.9)	
Attention hyperactivity problems		**2.3 (1.4-3.6)**	2.1 (1.3-3.3)	1.3 (0.8-2.2)	
Category unknown	**n (%)**				
Education of mother unknown	13 (1.2)	**2.4 (0.6-9.0)**		1.4 (0.4-5.4)	
Education of father unknown	117(11.1)	**2.3 (1.3-4.1)**	2.4 (1.3-4.3)	1.3 (0.8-2.2)	
Sleep problems unknown	178(16.8)	1.2 (0.7-1.7)		**0.9 (0.5-1.4)**	
Problems with eating unknown	188(17.8)	1.1 (0.7-1.7)		**1.0 (0.6-1.5)**	
Enuresis unknown	217(20.5)	**1.5 (1.0-2.3)**	1.6 (1.0-2.5)	**1.5 (1.0-2.1)**	1.6 (1.1-2.4)
Positive social behavior unknown	77 (7.3)	1.0 (0.5-2.0)		0.9 (0.5-1.6)	
Behavioral problems unknown	77 (7.3)	**1.0 (0.5-1.9)**		1.1 (0.6-1.9)	
Emotional problems unknown	77 (7.3)	0.9 (0.5-1.7)		1.0 (0.6-1.8)	
Attention hyperactivity unknown	77 (7.3)	**1.0 (0.5-2.0)**		1.1 (0.6-1.9)	

Criterion p<0.2 for inclusion in multivariate model

*adj = adjusted for all other variables which are included in the model

Table 4. Specificity, sensitivity, positive predictive value and negative predictive value for externalizing and internalizing problems in the validation set

	Sensitivity %	Specificity%	Positive predictive value %	Negative predictive value %
Externalizing	95	10	14.2	94.1
	25	90	32.2	88.4
Internalizing	91	10	16.0	98.1
	15	90	25.0	83.8

Figure 1A. The AUC for a clinical externalizing problem score on the CBCL

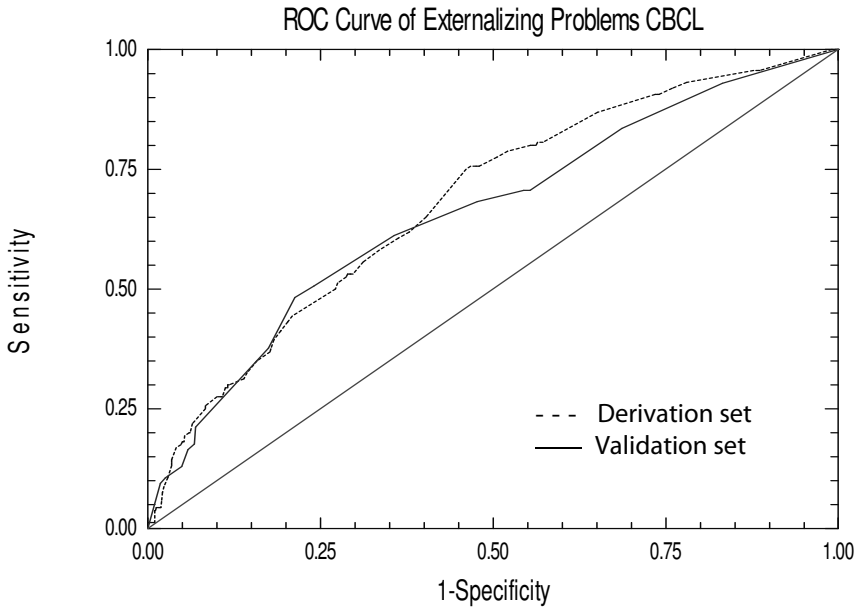
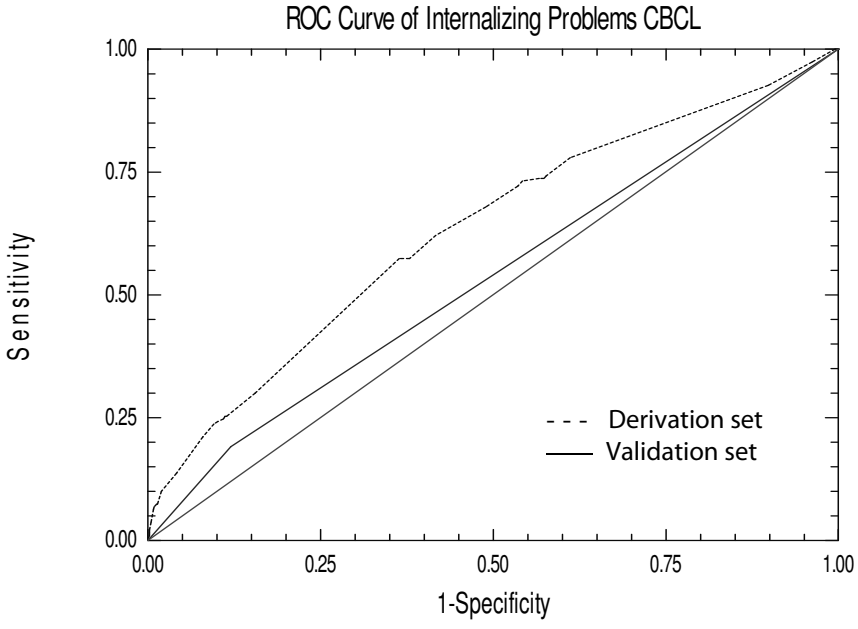


Figure 1B. The AUC for a clinical internalizing problem score on the CBCL



Comment

This study is the first to use early developmental data as registered by PCH to predict psychosocial problems in children in a longitudinal community-based sample. We found that the predictive power of PCH-registered early developmental data was rather modest for behavioral problems, with AUC indices being 0.66 (95% CI 0.59-0.72). This means that, PCH-registered early developmental data correctly predict externalizing problems in children at age 11 in 66% of cases. However, for internalizing problems, PCH data are not found to predict emotional problems in preadolescence.

For emotional and behavioral problems at age 11, the predictive power of PCH-registered findings on early development was low to modest. Some caution is needed when interpreting AUC indices, however, because the average AUC for prediction models can vary quite broadly, depending on the research field. For example, in prognostic reproductive medicine (for predicting pregnancy), AUC indices between 0.56 and 0.64 are reported.[21] Furthermore, Diamond[22] has shown in a simulation model that the AUC for a perfectly calibrated model would be 0.83 at best for prognostic studies (versus diagnostic studies). PCH professionals thus identify and register early developmental findings in routine practice that are predictive to some extent.

PCH-registered findings on early development do modestly predict later behavioral problems in preadolescence. This finding confirms previous findings in other studies of early predictors for behavioral problems, which found that externalizing problems[23,24] and attention hyperactivity problems[25] in childhood predicted later psychosocial problems. Other studies found that problems with enuresis in children were associated with behavioral problems.[26,27] Low SES (low education of the parents) and maternal smoking have consistently been shown to increase the risk for psychosocial problems, especially for behavioral problems.[28-31] Our findings show that PCH professionals do indeed identify and register the predictive factors that are found in these previous studies.

Findings on early development as registered by PCH are mostly not predictive for emotional problems in preadolescents. In contrast to our results, Mesman and Koot[32] found that early preschool internalizing problems were predictive for preadolescent internalizing problems. However, they measured early preschool items at age 2-3 years and used questionnaires instead of PCH-registered data. A second explanation for this might simply be that few early childhood features are predictive for later emotional problems.[23,28,32-34] A third possibility is that PCH professionals might not be adequately identifying or registering those factors that are predictive.

Surprisingly, being male is predictive for internalizing problems in our derivation set. The research, however, shows that in this age group similar prevalence rates are found among boys and girls for internalizing problems.[35,36] One explanation may be that, because of the gender-specific cut-off points for the CBCL, gender differences were already taken into account.

Psychosocial problems were more likely if PCH had not registered findings on some aspects of early development, that is, if these data were missing. This implies that these data were probably not missing at random. Several explanations could be given as to why PCH professionals did not always register every item. First, the PCH professional might not have had enough time for the assessments and registration especially in multiple-problem cases (the visits are short, with many competing concerns). Second, certain parents of children with problems may have given unclear answers or refused to answer some questions at all. Whatever the reason, missing PCH-registered data may be considered to be rather predictive for future problems.

The strengths of this study lie in its large sample and its embedding in routine PCH, a program that contacts over 90% of the total population. Moreover, we made use of data registered during the routine health and developmental monitoring that is offered to all Dutch children, and collected and registered according to a highly standardized format. TRAILS has had a high response rate and there was a high percentage of informed consent for retrieving the PCH files. In addition, using multiple predictors is a major strength. Recent overviews have shown that in most prognostic studies, single rather than multiple predictors may be investigated, but that multiple predictors provide better models.[37,38]

Some limitations should be taken into account when interpreting the study results. First, the children may have received effective treatment for their psychosocial problems between the ages of 4 and 11, leading to an underestimation of the predictive power of PCH findings. Second, the fact that our sample had fewer cases with externalizing problems than those without PCH files may also have led to an underestimation. Third, though we consider the CBCL questionnaire as the gold standard, we cannot exclude that it might also be subject to error in terms of the identification of the relevant children. For instance, the sensitivity and specificity of the Dutch version at the cut-off for the clinical range are 0.66 and 0.82, respectively.[16] Fourth, some predictors had a rather low prevalence, which limited the likelihood that they would be included in our predictive model, even if they were very predictive.

For better clinical decision-making in the future, early identification should be further improved. PCH identifies children at risk for psychosocial problems to a certain degree, thus showing its added value, but effort is needed for further improvement. Previous research has shown that the use of validated questionnaires, training of PCH professionals in a structured method for identifying psychosocial problems, and providing more time for the assessment may improve the accuracy of this early identification.[39,40] This study may add to the improvement of the quality of early identification in routine practice by indicating the predictors for behavioral problems that should be monitored.

This study was the first to use early developmental data, as registered by PCH, to predict psychosocial problems and it needs to be confirmed. Further research is needed to find those factors that are early predictors of internalizing problems and to improve the identification of such factors by PCH. Our results show that there is still ample room for improving child and

adult health further through better early identification and treatment. The findings on early development as registered in the PCH files are modestly predictive for externalizing problems in preadolescents.

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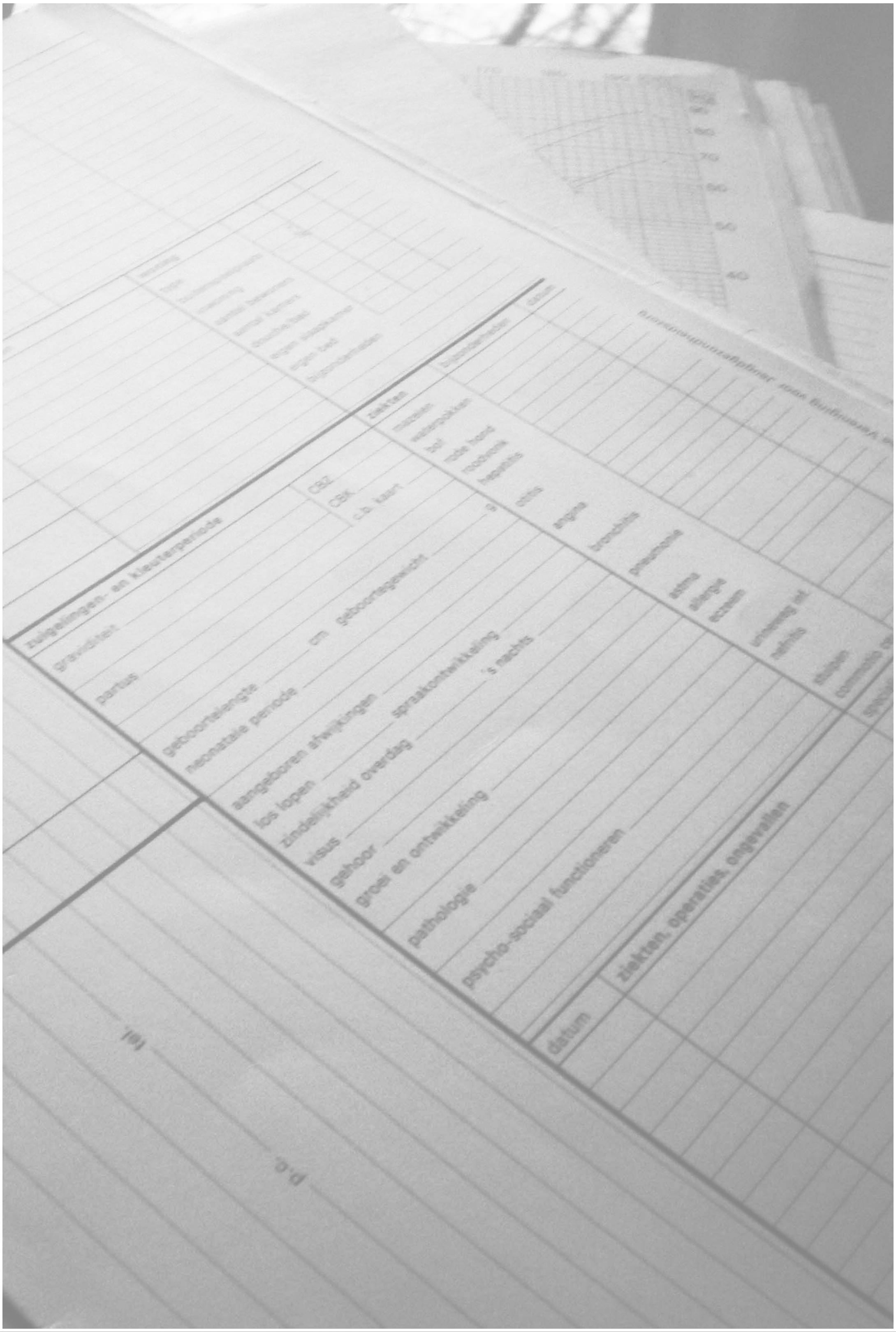
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3

Trajectories of psychosocial problems in adolescents predicted by findings from early well-child assessments

M. Jaspers
A.F. de Winter
M. Huisman
F.C. Verhulst
J. Ormel
R.E. Stewart
S.A. Reijneveld

Submitted

Abstract

Purpose

Research results on trajectories of emotional and behavioral problems are rather heterogeneous. To describe trajectories of emotional and behavioral problems in adolescents and to identify early indicators of these trajectories out of data from routine well-child assessments, at ages 0-4 years.

Methods

Data from three assessment waves of adolescents (n=1816) of the Tracking Adolescents' Individual Lives Survey (TRAILS) were used (ages 11-17). Information on early indicators (ages 0-4 years) came from the records of the well-child services. Trajectories of emotional and behavioral problems were based on the parent-reported Child Behavior Checklist (CBCL) and the adolescent-reported Youth Self Report (YSR), filled out at ages 11, 14 and 17. Multinomial logistic regression was used to examine the predictive value of these early indicators on trajectories.

Results

For boys and girls we found four trajectories for each outcome, one with high problem levels, and three with middle high, middle low, and low levels. For emotional problems, the type of trajectory was predicted by parental educational level and parental divorce or single parents, for both genders. Moreover, for boys sleep problems were predictive and for girls language problems (odds ratios between 1.53-7.42). For behavioral problems, the trajectories' type was predicted by maternal smoking during pregnancy, parental educational level, and parental divorce or single parents, for both genders. Moreover, for boys early behavioral problems and attention hyperactivity problems were predictive (odds ratios between 1.64-5.43).

Conclusion

Trajectories of emotional and behavioral problems during adolescence are rather stable and can be predicted by a parsimonious set of data from early well-child assessments.

Introduction

Emotional and behavioral problems are very prevalent during childhood and adolescence. Patterns vary across ages, though the underlying aspects are rather stable, which limits the value of studies at a single point in time[1,2]. Therefore, studying the trajectories of emotional and behavioral problems has been recommended.[3] So far, trajectory studies have looked at the disorder level[2,4-6] and not at the broad range of emotional and behavioral problems, whereas indicated prevention mostly targets at children with increased problem levels.[7]

Evidence on trajectories of emotional and behavioral problems is rather heterogeneous with some studies showing only slight to moderate variation in problem levels[2,8], while others showed rather big variation over time.[2,4,9] Evidence on gender differences lacks, but these are likely to occur. First, prevalence rates differ by gender, depending on the type of problems.[10-12] Second, girls have been shown to develop relatively more emotional problems during adolescence than boys.[5,6,10]

Well-child care, or preventive child health care, aims to identify children at risk for various problems, including emotional and behavioral ones, especially the more severe problem behavior. In particular preschool age has been shown to be very important for children's further development and functioning.[13,14] However, evidence on early indicators that discriminate between different trajectories is scarce, with previous studies measuring an outcome at a single time point,[15-18] focusing on disorders, and/or assessing parental and peer relationships as predictors.[8,19-21]

Community-based well-child services are uniquely positioned for the early identification of children at risk for psychosocial problems. In the Netherlands, well-child professionals provide health and developmental monitoring to the entire Dutch population from birth until young adulthood.[22] Evidence lacks on the degree to which their findings are predictive for trajectories of emotional and behavioral problems in adolescents. The aim of the present study is to describe these trajectories of emotional and behavioral problems in adolescents and to identify early indicators of these trajectories out of data from routine well-child assessments.

Methods

Sample

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study of Dutch preadolescents and adolescents.[23,24] The present study used data from the first (n=2230, mean age=11.09, SD=0.56), second (n=2149, mean age=13.55, SD=0.54), and third wave (n=1819, mean age=16.26, SD=0.73). Parents of 2139 children (96%) gave written informed consent to retrieve data from the well-child records. Out of these, 84.9% could be traced (n=1816 well-child files). Children with and without a well-child file differed as to the prevalence of parent-rated behavioral problems (14.4% for the retrieved vs. 20.0% for the

non-retrieved, p<.05) but did not differ statistically regarding parent-rated emotional problems (16.6% vs. 18.2%, respectively, p>.05) at T1. The TRAILS study was approved by the Dutch National Medical Ethics Committee.

Emotional and behavioral problems: outcomes

Emotional and behavioral problems were assessed using the adolescent-reported Youth Self-Report (YSR) and the parent-reported Child Behavior Checklist (CBCL) at each wave. The validity of both instruments has been documented extensively.[25,26] They consist of 120 questions about the previous six months, each coded as: 0= not true; 1= somewhat/sometimes true; and 2= very/often true. 'Emotional problems' consists of the anxious/depressed, somatic complaints, and withdrawn/depressed syndrome scales. 'Behavioral problems' consists of the aggressive behavior and delinquent behavior syndrome scales. Multi-informant information is known to be a better predictor of disorder than information from only one informant.[27,28] We therefore computed the average of the raw scores on the YSR and CBCL, giving equal weight to both informants.

Early development

Data on early development were obtained from well-child records, in which information from all well-child visits had been recorded. These visits are provided free of charge; covering about 95% of the population. For ages 0-4 years, on average 12 visits are provided by community physicians and nurses (well-child professionals). The assessments included a general physical examination, standardized screening procedures and a semi-structured interview with parents concerning health status and physical, emotional and behavioral developmental problems, all of which were recorded in the well-child file. An assessment generally takes approximately 10 to 15 minutes. In accordance with the literature, we selected all the potentially relevant factors from the well-child file: prenatal and perinatal factors, early motor and social development, and family characteristics.[15-18,30-32]

Prenatal and perinatal risks

Maternal smoking and alcohol use were assessed by two questions: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?"[30] Low birth weight was defined as <2500 grams.[32] Gestational age was registered in weeks. These questions were part of the PCH files, but were also part of the T1 interview in TRAILS (when a child was 11 years old). If the answer was missing for the well-child file then we enriched the data with the data from TRAILS. Birth complications, for example, included abruption, preterm rupture, meconium in amniotic fluid, and pre-eclampsia, and they were dichotomized to a "yes" if any of these were present, and to a "no" if there were none.

Early motor and social development

Early motor and social development, from birth to four years of age, were assessed using four indices. The first was the Van Wiechen Scheme, for one to 15 months of age, which is the Dutch equivalent of the Bayley scales.[31] These indicators were divided into three different subcategories: gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items); each of them was targeted towards children of a predetermined age. The items were summed within these three subcategories and then dichotomized as "yes" if any problems were present, or "no".

Second, the well-child professional assessed problems in motor and language development at six occasions between ages 18 months to four years. Examples of these developmental problems are: delays in motor skills and speech delay. Findings were then dichotomized to "yes" if any problems were present during one or more of these six occasions, and "no" if otherwise.

Third, from age 18 months to four years, the well-child professional systematically asked parents about sleeping and eating behavior. The responses were dichotomized to "yes" if any of these problems were present during one or more of the six visits, and a "no" if there were none.

The fourth index concerned well-child-registered behavioral features, noted at six assessments between the ages of 18 months to four years. Parents' disclosures concerning playing, behavior, and social behavior were systematically assessed and recorded by well-child professionals using short descriptions such as "overactive," "shy," "anxious," or "aggressive" (see Chapter 4). These were categorized as behavioral problems, emotional problems, attention hyperactivity problems, social problems in behavior, or positive behavior and were then dichotomized to "yes" if any of these were present during these six occasions, and "no".

Family characteristics

Parental educational level, based on the parent with the highest level, was allocated to three levels: low (at the lowest levels of secondary education), medium (higher levels of secondary education), and high (higher vocational or university degree). If both answers were missing for the well-child file we enriched the data with the data from TRAILS. The living situation was classified into two groups: living with both biological parents versus divorced parents, stepparent(s), or single-parent households.

Analyses

Multiple imputation of missing data

To prevent missing data in our indicators we combined data on several visits and if that was not possible we supplemented missing values by retrospectively collected information at T1 (n=1816 well-child files). At the assessment waves, data were missing for 5.6% at T1 to 34.2%

at T3 for the subscales of the YSR and the CBCL. These were imputed, based on the multivariate normal model,[33,34] as implemented in the NORM software.[35] This procedure minimizes the loss of statistical power, provides correctly estimated standard errors, and preserves the characteristics of the data set as a whole.[36] It is based on the assumption that, given the observed data, missing values are random.[36] However, violations have been shown to have only minor effects,[37] and if any, these were further reduced by using all observed information in a multivariate imputation model in which possible relations between missing values and observed data are modeled.[38]

All missing values were imputed ten times to achieve good efficiency of estimation and sufficient statistical power.[33,36] The imputed datasets were then pooled to build trajectories in which the results (from the mean of the ten datasets) were combined to obtain estimates of parameters and standard errors. These estimates then correctly reflected both sampling variability and the additional uncertainty due to missing data and imputation.

Statistical analyses

First, we computed trajectories for each adolescent using latent class (LC) regression analyses on the data for all three measurement waves, doing so separately for boys and girls. The trajectories were constructed from the mean of the ten imputed datasets. LC regression analysis enables groups of individuals to be categorized into mutually exclusive classes based on their trajectories, followed by their responses to a single outcome variable over time. Because the outcome variables concerned count data, Poisson regression models were used that allowed overdispersion in a negative binomial distribution.[39] To determine the optimal number of classes, the Bayesian information criterion (BIC) was used (see Appendix 1).[40] Using the BIC criterion, this yielded four categories which we labeled as a high trajectory of adolescents with problem levels in the clinical range, and a middle high, middle low, and a low trajectory.

Next, we used multinomial logistic regression (MNL) analysis to assess the relationship between early developmental indicators and trajectories, again separately for boys and girls. A MNL model with four outcomes is roughly equivalent to running three binary logistic regressions, except that all parameters are estimated simultaneously, which enables the predictive power of independent variables to be assessed across all outcome levels.[41] These analyses were performed in two steps. First, we assessed the crude effect of each variable on the outcomes separately. We had chosen these variables based on the available evidence on which variables might be predictive, and on whether data on these variables were recorded in routine PCH. All variables with an association at $p<.20$ were used in the second step. In this second step, we constructed a final model using backward regression with $p<.05$ as criterion regarding the contribution of each variable. The statistical analyses were performed using Latent GOLD[39] and SPSS version 16.

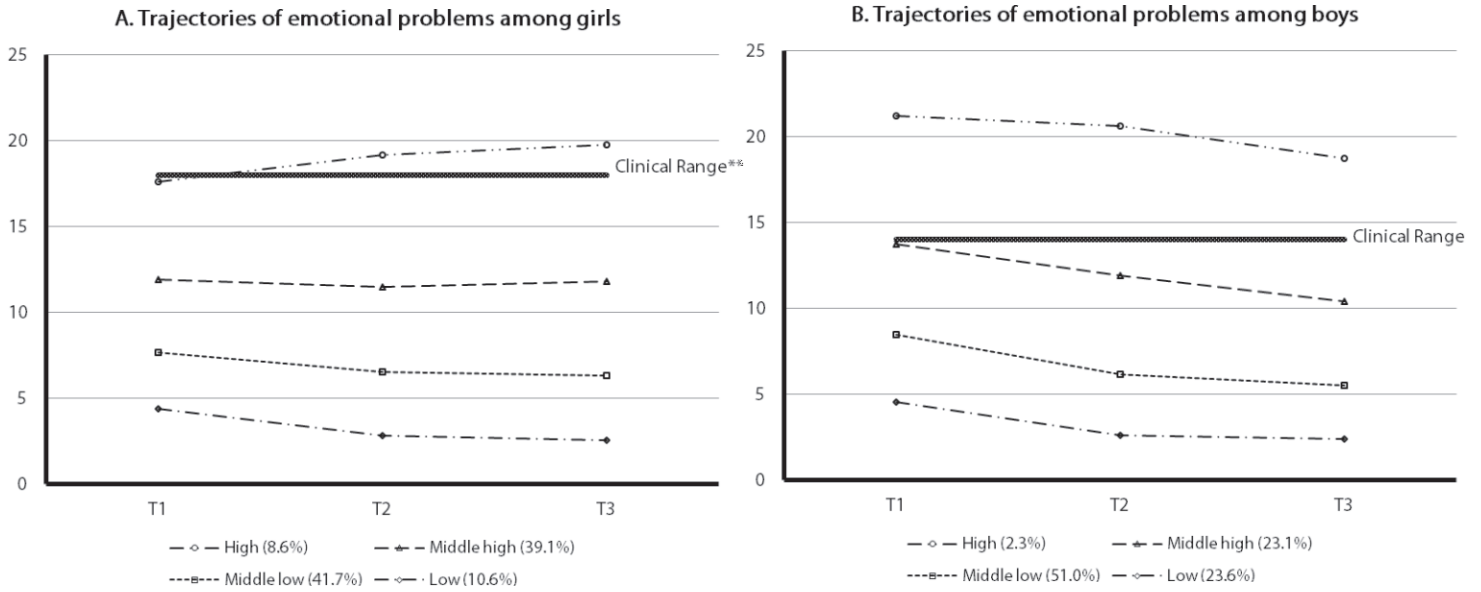
Results

Figure 1 shows the trajectories of emotional and behavioral problems for girls and boys. Of the 932 girls, 80 (8.6%) were in the trajectory of clinical emotional problems, while 20 of the 884 boys (2.3%) were in this group. In the clinical behavioral group, there were 39 girls (4.2%) and 76 boys (8.6%) (see Figure 1).

Table 1 shows crude and mutually adjusted odds ratios (OR) for the relation between well-child predictors and the four groups of trajectories, for emotional and for behavioral trajectories, in both girls and boys during adolescence. For the group of trajectories of emotional problems in girls, the significant predictors were language and speech problems, having divorced or single parents, and parents with a low educational level (odds ratios, ORs, between 2.72-7.42). Estimates of the associations of language and speech problems with this group of trajectories were rather inaccurate, indicated by fairly wide confidence intervals and unstable estimates. Therefore, we repeated the analyses without this predictor. When doing that, early emotional problems were included as predictor in the model. For the group of trajectories of emotional problems in boys the identified predictors were maternal smoking during pregnancy, early sleep problems, and having parents with a low or medium educational level (ORs between 1.53-5.43), while maternal alcohol use during pregnancy was a protective predictor in the emotional model (OR 0.63).

Predictors for the group of trajectories of behavioral problems in girls were maternal smoking during pregnancy, having divorced or otherwise single parents, and having parents with a low or medium educational level (ORs between 1.69-5.41), while gross motor problems was a protective predictor (OR 0.44). Attention hyperactivity problems did not contribute to the model. For the group of trajectories for behavioral problems in boys, maternal smoking during pregnancy, early behavioral problems, attention hyperactivity problems, the absence of any positive reported behavior, a low level of parental education, and having divorced or otherwise single parents were predictors (ORs between 1.59-4.25).

Figure 1A-D. Trajectories of emotional and behavioral problems among girls and boys.*



*Due to rounding, numbers do not add up to 100% everywhere.

** Clinical Range is the average of the CBCL and the YSR clinical ranges.[25,26]

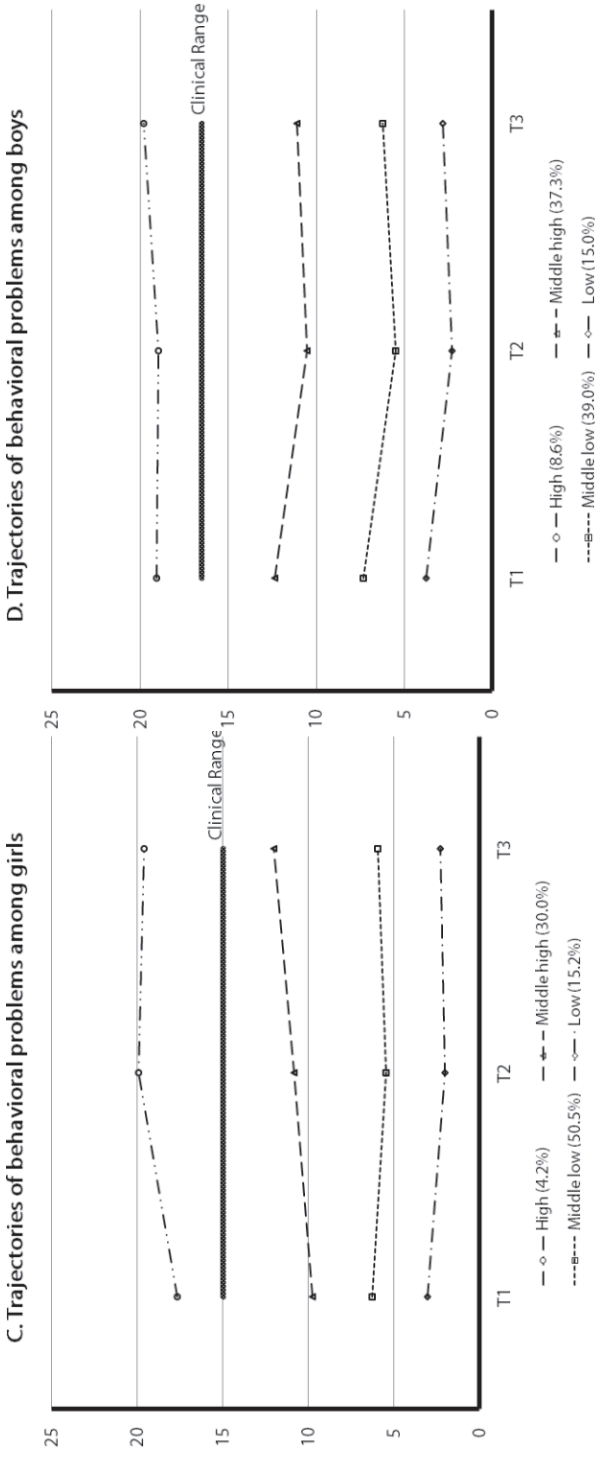

C. Trajectories of behavioral problems among girls
25
20
15
10
5
0
Clinical Range
T1
T2
T3
High (4.2%)
Middle high (30.0%)
Middle low (50.5%)
Low (15.2%)
D. Trajectories of behavioral problems among boys
25
20
15
10
5
0
Clinical Range
T1
T2
T3
High (8.6%)
Middle high (37.3%)
Middle low (39.0%)
Low (15.0%)

Table 1. Multinomial logistic regression on level of emotional and behavioral problems for adolescents: Odds ratios, OR (and 95% confidence intervals, CI)

Table 1A. Emotional problems for girls

n = 932	High problems 80 (8.6%)		Middle high problems 364 (39.1%)		Middle low problems 389 (41.7%)		Low problems 99 (10.6%)
Variable	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	1.23 (0.62-2.49)		0.88 (0.51-1.53)		0.90 (0.53-1.55)		1
Maternal smoking during pregnancy	1.30 (0.69-2.44)		1.25 (0.77-2.02)		1.03 (0.63-1.67)		1
Low birth weight (< 2500 grams)	0.48 (0.09-2.55)		1.45 (0.54-3.88)		1.35 (0.50-3.60)		1
Birth complication	0.97 (0.49-1.94)		0.89 (0.53-1.51)		0.81 (0.48-1.36)		1
Early motor and social development							
Gross motor skills delay (age 1-15 mos.)	0.72 (0.36-1.44)		**0.58 (0.35-0.97)**		**0.56 (0.35-0.98)**		1
Fine motor skills delay	0.82 (0.22-3.00)		0.85 (0.33-2.20)		1.20 (0.48-2.99)		1
Communication delay	2.28 (0.64-8.08)		1.31 (0.44-3.94)		1.56 (0.53-4.61)		1
Motor problems (age 1.5 - 4 yrs.)	3.93 (0.77-20.0)		3.27 (0.76-14.1)		1.41 (0.31-6.47)		1
Language and speech problems	**6.93 (1.47-32.61)**	**7.42 (1.56-35.31)**	2.67 (0.61-11.67)	2.78 (0.63-12.21)	3.05 (0.71-13.15)	3.12 (0.72-13.49)	1
Sleep problems	1.27 (0.66-2.45)		0.82 (0.49-1.38)		0.97 (0.58-1.61)		1
Problems with eating	0.91 (0.50-1.64)		1.36 (0.87-2.13)		1.18 (0.76-1.84)		1
Behavioral problems	1.40 (0.76-2.58)		1.10 (0.68-1.76)		1.03 (0.64-1.65)		1
Emotional problems	**2.06 (1.02-4.20)**		0.93 (0.52-1.69)		1.11 (0.62-1.99)		1
Social problems in behavior	0.82 (0.22-3.00)		1.09 (0.43-2.76)		0.71 (0.27-1.85)		1
Attention hyperactivity problems	0.86 (0.45-1.62)		0.88 (0.55-1.41)		0.85 (0.53-1.36)		1
No positive behavior reported	1.44 (0.79-2.63)		1.11 (0.79-1.75)		1.25 (0.79-1.96)		1
Family characteristics							
Low educational level of parents	**2.60 (1.01-6.73)**	**2.47 (1.03-5.91)**	1.26 (0.64-2.50)	1.42 (0.74-2.73)	1.78 (0.92-3.44)	1.85 (0.98-3.50)	1
Middle educational level of parents	**2.79 (1.31-5.95)**	**2.27 (1.11-4.62)**	1.37 (0.82-2.29)	1.26 (0.77-2.07)	1.11 (0.67-1.85)	1.10 (0.67-1.81)	1
Divorced parents or one parent	**3.17 (1.39-7.21)**	**3.04 (1.32-7.00)**	**3.05 (1.53-6.12)**	**2.73 (1.35-5.51)**	**2.06 (1.02-4.15)**	1.76 (0.86-3.58)	1

Criterion p<.20 for inclusion in multivariate model

*adj = adjusted for all other variables which are included in the multivariate model

Table 1B. Emotional problems for boys

n = 884	High problems 20 (2.3%)		Middle high problems 204 (23.1%)		Middle low problems 451 (51.0%)		Low problems 209 (23.6%)
Variable	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	0.48 (0.14-1.71)	0.47 (0.13-1.74)	0.86 (0.55-1.35)	0.96 (0.60-1.53)	**0.55 (0.37-0.82)**	**0.63 (0.42-0.95)**	1
Maternal smoking during pregnancy	1.33 (0.49-3.64)	1.23 (0.40-3.72)	**2.04 (1.34-3.11)**	**1.82 (1.17-2.81)**	1.34 (0.92-1.95)	1.25 (0.85-1.84)	1
Low birth weight (< 2500 grams)	1.78 (0.20-15.57)		2.30 (0.86- 6.18)		1.16 (0.45-3.04)		1
Birth complication	2.02 (0.76-5.37)		0.97 (0.61-1.56)		1.20 (0.80-1.78)		1
Early motor and social development							
Gross motor skills delay (age 1-15 mos.)	0.99 (0.32-3.13)		0.93 (0.57-1.51)		1.08 (0.72-1.62)		1
Fine motor skills delay	2.46 (0.64-9.40)		1.12 (0.53-2.39)		1.25 (0.66-2.36)		1
Communication delay	1.11 (0.24 (5.16)		0.69 (0.33-1.44)		1.08 (0.62-1.90)		1
Motor problems (age 1.5 - 4 yrs.)	-		2.55 (0.88-7.37)		1.40 (0.50-3.92)		1
Language and speech problems	0.86 (0.11-7.01)		1.78 (0.85-3.75)		1.25 (0.63-2.49)		1
Sleep problems	**4.86 (1.89-12.49)**	**5.43 (2.05-14.40)**	**1.62 (1.03-2.55)**	**1.64 (1.03-2.60)**	1.44 (0.97-2.15)	1.35 (0.90-2.04)	1
Problems with eating	1.49 (0.59-3.73)		**1.74 (1.18-2.57)**		**1.55 (1.11-2.16)**		1
Behavioral problems	1.86 (0.74-4.67)		1.46 (0.99-2.16)		1.03 (0.74-1.44)		1
Emotional problems	1.10 (0.30-3.97)		1.11 (0.64-1.92)		1.34 (0.84-2.12)		1
Social problems in behavior	1.34 (0.29-6.29)		1.10 (0.54-2.23)		1.30 (0.72-2.37)		1
Attention hyperactivity problems	0.66 (0.25-1.80)		1.32 (0.90-1.96)		1.22 (0.88-1.71)		1
No positive behavior reported	**3.42 (1.26-9.21)**		1.35 (0.91-1.99)		1.26 (0.90-1.76)		1
Family characteristics							
Low educational level of parents	0.50 (0.10-2.40)	0.74 (0.19-2.52)	1.43 (0.82-2.50)	1.49 (0.86-2.58)	**1.94 (1.21-3.10)**	**1.70 (1.07-2.69)**	1
Middle educational level of parents	0.54 (0.16-1.79)	0.57 (0.18-1.80)	**1.65 (1.04-2.62)**	**1.63 (1.02-2.59)**	**1.75 (1.18-2.59)**	**1.53 (1.04-2.27)**	1
Divorced parents or one parent	2.35 (0.79-6.99)		**2.11 (1.25-3.56)**		**1.71 (1.06-2.74)**		1

Criterion p<.20 for inclusion in multivariate model

*adj = adjusted for all other variables which are included in the multivariate model

Table 1C. Behavioral problems for girls

n = 932	High problems 39 (4.2%)		Middle high problems 280 (30.0%)		Middle low problems 471 (50.5%)		Low problems 142 (15.2%)
Variable	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	0.89 (0.34-2.37)		1.26 (0.74-2.13)		1.33 (0.81-2.17)		1
Maternal smoking during pregnancy	**2.35 (1.13-4.87)**	1.56 (0.73-3.35)	**1.94 (1.25-3.01)**	**1.69 (1.06-2.70)**	0.99 (0.65-1.51)	0.94 (0.60-1.46)	1
Low birth weight (< 2500 grams)	0.71 (0.15-3.40)		0.70 (0.30-1.61)		1.00 (0.48-2.07)		1
Birth complication	0.81(0.31-2.14)		1.27 (0.76-2.11)		1.36-0.85-2.19)		1
Early motor and social development							
Gross motor skills delay (age 1-15 mos.)	0.42 (0.16-1.07)	0.43 (0.17-1.13)	**0.43 (0.26-0.70)**	**0.44 (0.27-0.73)**	**0.51 (0.34-0.79)**	**0.51 (0.33-0.79)**	1
Fine motor skills delay	0.31 (0.04-2.51)		0.97 (0.45-2.06)		0.64 (0.31-1.34)		1
Communication delay	0.91 (0.18-4.45)		0.69 (0.30-1.74)		1.26 (0.57-2.80)		1
Motor problems (age 1.5 - 4 yrs.)	3.94 (0.94-16.56)		1.68 (0.54-5.25)		1.61 (0.54-4.77)		1
Language and speech problems	2.20 (0.61-7.96)		1.17 (0.47-2.91)		1.17 (0.50-2.75)		1
Sleep problems	2.09 (0.97-4.51)		1.42 (0.88-2.29)		1.05 (0.66-1.65)		1
Problems with eating	1.09 (0.54-2.22)		1.27 (0.85-1.91)		1.34 (0.92-1.95)		1
Behavioral problems	1.59 (0.76-3.35)		1.42 (0.91-2.20)		1.34 (0.89-2.02)		1
Emotional problems	1.10 (0.46-2.66)		0.84 (0.50-1.42)		1.03 (0.64-1.67)		1
Social problems in behavior	0.91 (0.18-4.45)		1.36 (0.59-3.15)		0.74 (0.32-1.73)		1
Attention hyperactivity problems	**2.13 (1.01-4.73)**		1.50 (0.95-2.36)		1.31 (0.85-2.01)		1
No positive behavior reported	1.79 (0.88-2.66)		1.20 (0.80-1.82)		0.99 (0.68-1.46)		1
Family characteristics							
Low educational level of parents	**5.50 (1.59-19.03)**	**5.41 (1.76-16.64)**	1.19 (0.65-2.20)	1.44 (0.81-2.55)	1.10 (0.63-1.90)	1.33 (0.78-2.24	1
Middle educational level of parents	**4.55 (1.41-14.62)**	**3.90 (1.33-11.45)**	**1.80 (1.09-2.97)**	**1.82 (1.13-2.94)**	1.29 (0.81-2.04)	1.38 (0.89-2.13)	1
Divorced parents or one parent	**3.62 (1.68-7.78)**	**3.17 (1.43-7.03)**	**1.71 (1.03-2.84)**	1.57 (0.91-2.68)	0.96 (0.58-1.57)	0.97 (0.58-1.63)	1

Criterion p<.20 for inclusion in multivariate model

*adj = adjusted for all other variables which are included in the multivariate model

Table 1D. Behavioral problems for boys

n = 884	High problems 76 (8.6%)		Middle high problems 330 (37.3%)		Middle low problems 345 (39.0%)		Low problems 133(15.0%)
Variable	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	**OR (crude) 95% CI**	**OR (adj*) 95% CI**	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	0.73 (0.33-1.62)		1.48 (0.88-2.48)		1.28 (0.76-2.16)		1
Maternal smoking during pregnancy	**4.34 (2.25-8.37)**	**2.76 (1.37-5.59)**	**3.02 (1.79-5.12)**	**2.63 (1.53-4.52)**	**2.51 (1.50-4.25)**	2.36 (1.38-4.04)	1
Low birth weight (< 2500 grams)	0.87 (0.21-3.58)		1.22 (0.47-3.15)		0.50 (0.17-1.45)		1
Birth complication	0.78 (0.40-1.50)		0.83 (0.53-1.32)		0.70 (0.44-1.11)		1
Early motor and social development							
Gross motor skills delay (age 1-15 mos.)	0.87 (0.43-1.80)		0.93 (0.56-1.53)		1.10 (0.67-1.80)		1
Fine motor skills delay	0.86 (0.28-2.62)		1.14 (0.54-2.42)		0.99 (0.47-2.12)		1
Communication delay	1.01 (0.38-2.70)		1.12 (0.56-2.24)		0.82 (040-1.67)		1
Motor problems (age 1.5 - 4 yrs.)	0.28 (0.33-2.39)		0.66 (0.23-1.86)		0.96 (0.37-2.54)		1
Language and speech problems	0.97 (0.31-3.01)		1.14 (0.51-2.49)		1.12 (0.51-2.46)		1
Sleep problems	1.47 (0.76-2.86)		1.50 (0.91-2.45)		1.63 (1.00-2.66)		1
Problems with eating	1.14 (0.65-2.01)		1.38 (0.92-2.07)		1.36 (0.91-2.03)		1
Behavioral problems	**2.54 (1.42-4.55)**	**2.06 (1.10-3.86)**	**1.87 (1.23-2.86)**	**1.80 (1.16-2.80)**	1.48 (0.97-2.26)	1.46 (0.94-2.25)	1
Emotional problems	0.64 (0.28-1.47)		0.94 (0.55-1.60)		0.95 (0.56-1.61)		1
Social problems in behavior	0.86 (0.31-2.41)		0.97 (0.48-1.97)		1.03 (0.51-2.07)		1
Attention hyperactivity problems	**2.10 (1.18-3.71)**	**2.06 (1.10-3.86)**	1.31 (0.87-1.97)	1.26 (0.81-1.94)	1.09 (0.72-1.64)	1.07 (0.70-1.64)	1
No positive behavior reported	**1.92 (1.09-3.41)**	1.83 (0.98-3.42)	**1.56 (1.03-2.35)**	**1.59 (1.03-2.45)**	1.26 (0.77-1.74)	1.20 (0.78-1.83)	1
Family characteristics							
Low educational level of parents	**5.51 (2.13-14.25)**	**3.97 (1.60-9.83)**	1.55 (0.88-2.73)	1.03 (0.58-1.82)	1.16 (0.66-2.03)	1.03 (0.59-1.79)	1
Middle educational level of parents	**4.55 (1.88-11.00)**	**3.48 (1.48-8.20)**	**1.66 (1.03-2.67)**	1.37 (0.85-2.20)	1.32 (0.83-2.10)	1.24 (0.78-1.97)	1
Divorced parents or one parent	**6.47 (2.99-14.02)**	**4.25 (1.10-3.86)**	**3.10 (1.58-6.05)**	**2.58 (1.16-2.80)**	**2.10 (1.07-4.16)**	1.85 (0.92-3.70)	1

Criterion p<.20 for inclusion in multivariate model

*adj = adjusted for all other variables which are included in the multivariate model

Discussion

This study is the first to assess early indicators for trajectories of emotional and behavioral problems in adolescents, based on data from routine well-child assessments in a large longitudinal community-based sample. We identified groups of four trajectories, similarly for both genders and for emotional and behavioral problems. Each group comprised a high trajectory of clinical problems, and a middle high, middle low, and low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from well-child assessments predicted each of these groups of trajectories. All sets comprised low and medium parental educational levels, and having divorced or otherwise single parents, for both genders. For trajectories of emotional problems, sleep problems were a unique predictor in boys and language problems in girls. Groups of trajectories of behavioral problems were predicted by maternal smoking during pregnancy for both genders. In addition, in boys early behavioral problems and attention hyperactivity problems were predictive.

We found that trajectories were rather stable, with only slight to moderate increases or decreases in problem levels. This is in line with the findings of Dekovic and colleagues[8] regarding emotional problems. Letcher and colleagues[9] found more variability in trajectories of emotional problems, but they mostly measured the anxiety dimension and not the whole spectrum of emotional problems. Regarding behavioral problems, Nagin and Tremblay[4] found four trajectories for physical aggression, opposition, and hyperactivity among boys. There was a chronic problem trajectory, and a middle high and middle low trajectory, both of which desisted over time, and a no problem trajectory.

Based on our findings, one might conclude that community-based assessments at age 11 already provide most of the information needed to identify groups with higher rates of problems. However, caution is needed, since developmental trajectories groups summarize the average behavioral trend at the group level. Not all individuals' behavioral trajectories will exactly match the group average.[42] Moreover, trajectories on broad groups of problems such as emotional and behavioral problems might not show much variety, while the composing symptoms might do so.

We found gender differences in the prevalence of these two broadband problems: girls experienced more emotional problems and boys experienced more behavioral problems, as has been found in many other studies.[8,9,11,12,19] Moreover, though overall relatively stable, problems increased by approximately 10% between ages 11 to 17 for girls in the clinical trajectory of emotional problems (from an average of 17.7 to 22.2), while there was a decrease for boys in this trajectory.

The predictors that we found for our trajectories of emotional and behavioral problems are partly in line with previous studies that measured predictors at the same time as the trajectories[4,9] and/or focused on parental and peer relationships.[8,19-21] In line with Letcher, we found that toddler emotional problems (including shyness) were predictive for a high

emotional trajectory; however, this was only predictive after removing the factor of language problems from our analyses. We did not replicate the finding of Letcher and colleagues[9] that early behavioral problems were predictive for high rates of adolescent emotional problems. Surprisingly, we also did not replicate the findings that early behavioral and attention hyperactivity problems were predictive for adolescent behavioral problems in girls.[43,44]

Our findings confirm the impact of early social disadvantage on adolescent emotional and behavioral problems, whereas previous findings were mixed.[9,45] We found that having a parent with a low and a medium educational level was predictive for groups of trajectories in both boys and girls, with a high trajectory of behavioral problems and for girls with a high trajectory of emotional problems. Previously, we developed and validated a prediction model for emotional and behavioral problems in preadolescence (T1 data).[29] There, we partially found the same predictors (as in this study), mainly regarding behavioral problems. Maternal smoking during pregnancy, low and medium parental educational level, and having divorced parents or a single parent were predictive for both genders with high trajectories of behavioral problems.

Strengths and limitations

Major strengths of our study concern its prospective nature, spanning many years from birth onwards, its high response rate, and its embedding in routine community-based well-child care. Moreover, we used a broad range of indicators, whereas most previous studies only used subsets of indicators, emotional and behavioral problems were identified based on both child and parent ratings, thus reducing measurement error.

Our study also has some limitations which may have led to underestimation of the predictive power of the well-child findings. First, children may have received effective treatment for their psychosocial problems between the ages of 4 and 11 in early intervention programs. Well-child professionals have been shown to undertake action in 85% of the cases in which they identify psychosocial problems, including an intended referral for further diagnostics and treatment in 20%.[22,46] This may have led to some reduction of problems in adolescence, thus lowering the predictive power of early well-child findings.

Second, some highly predictive early-risk indicators may not have been identified as indicators due to their low prevalence. Third, we didn't control for parental psychopathology. Some indicators, such as smoking during pregnancy and low SES, might be associated with genetically determined higher levels of behavioral problems on the part of the parents[47] implying that causal inferences should be made cautiously. Fourth, the CBCL and YSR questionnaires may also be subject to error in terms of the identification of relevant children, which would decrease the predictive power of indicators. For instance, for the CBCL the sensitivity and specificity of the Dutch version, in terms of the cut-off for clinical range, are 0.66 and 0.82, respectively.[26]

Our findings have several implications for well-child services. First, they support the importance of prevention of smoking during pregnancy.[30] Second, they show the value of

early childhood monitoring to identify children at risk for trajectories of high rates of emotional and behavioral problems. Third, given the continuity of emotional and behavioral problems, they also show the importance of continued monitoring during adolescence.

This study is the first to assess the predictive power of early well-child findings on adolescent trajectories of emotional and behavioral problems, implying that its results need to be confirmed. This should also comprise trajectories of co-occurring emotional and behavioral problems, given the frequent occurrence of these.[48]

In conclusion, trajectories of emotional and behavioral problems during adolescence are remarkably stable and can be predicted by a parsimonious set of data from early well-child assessments. The well-child setting may play an important role in prevention by monitoring children at risk for developing these stable problems, by administering diagnostic instruments to further qualify their symptoms, and by providing early treatment if needed.

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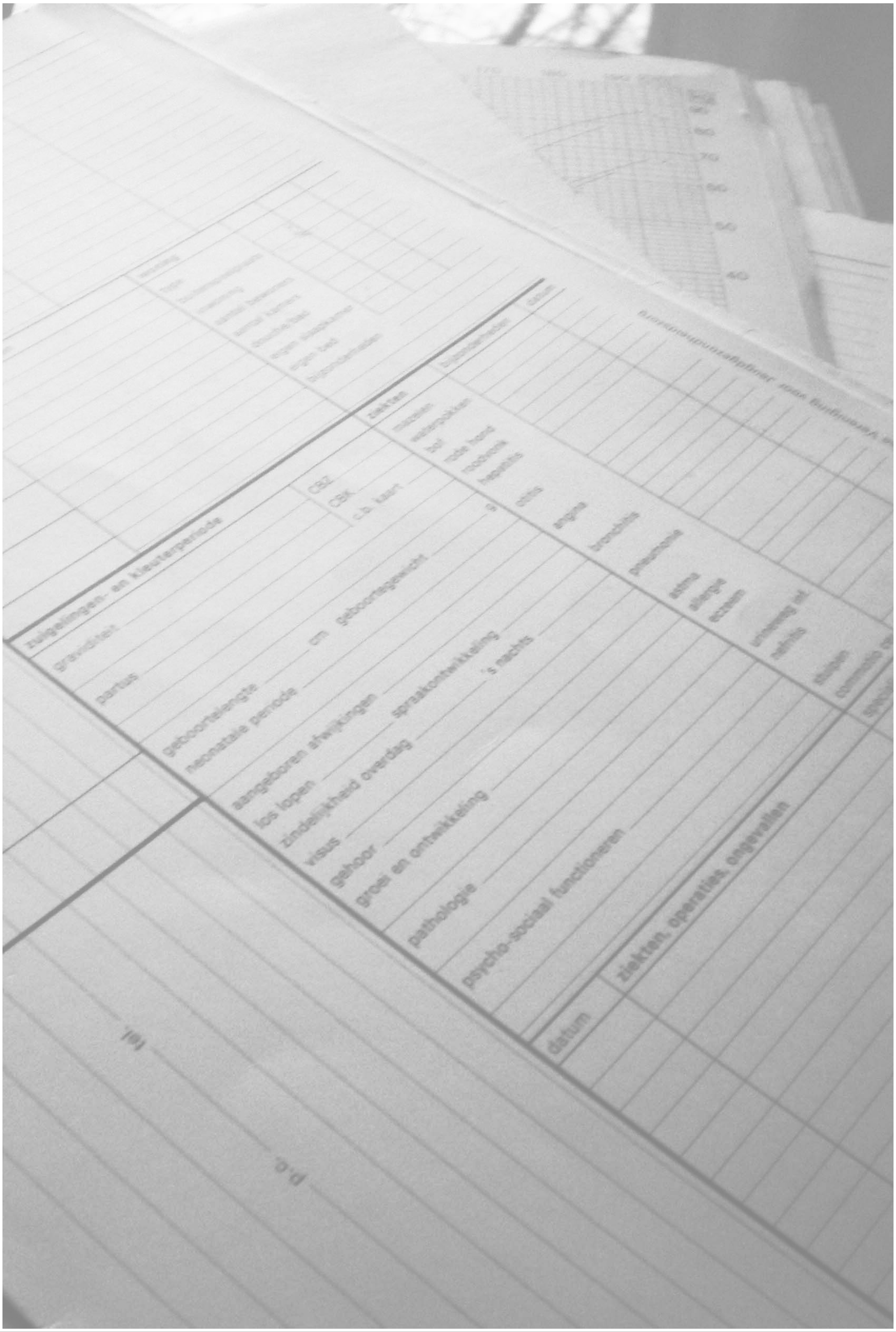
Appendix 1. Fit statistics for LCA models

Group	Class	Solution	Number of parameters	Log-likelihood	Bayes information criterion*
Female	3	Emotional	14	-9946.74	19991.93
	4		19	-9916.77	**19967.14**
	5		24	-9908.55	19985.87
Male	3	Emotional	14	-8986.64	18071.29
	4		19	-8949.81	**18032.64**
	5		24	-8943.32	18054.67
Female	3	Behavioral	14	-9372.08	18842.59
	4		19	-9309.80	**18753.20**
	5		24	-9302.42	18773.59
Male	3	Behavioral	14	-9423.90	18945.82
	4		19	-9392.21	**18917.44**
	5		24	-9378.94	18925.91

*Best model is indicated in bold


zuigelingen- en kleuterperiode
graviditeit
partus
geboortelengte
cm
geboortegewicht
neonatale periode
aangeboren afwijkingen
los lopen
spraakontwikkeling
zindelijkheid overdag
's nachts
visus
gehoor
groei en ontwikkeling
pathologie
psycho-sociaal functioneren
ziekten
mazelen
waterpokken
bof
rode hond
roodvonk
hepatitis
otitis
angina
bronchitis
pneumonie
astma
allergie
eczeem
datum
ziekten, operaties, ongevallen

4

Early childhood assessments of community pediatric professionals predict autism spectrum and attention deficit hyperactivity problems

M. Jaspers
A. F. de Winter
J. K. Buitelaar
F. C. Verhulst
S. A. Reijneveld
C. A. Hartman

Submitted

Abstract

Background

For clinically referred children with Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADHD) several early indicators have been described. However, knowledge is lacking on early markers of less severe variants of ASD and ADHD from the general population. The aim of the present study is to identify early indicators of high risk groups for ASD and ADHD problems based on routine data from community pediatric services between infancy and age four.

Methods

Data are from 1816 participants who take part in Tracking Adolescents' Individual Lives Survey (TRAILS), a longitudinal study. Information on early developmental factors was extracted from charts of routine Preventive Child Healthcare (PCH) visits. To assess ASD and ADHD problems, respectively, we used the Children's Social Behavior Questionnaire (CSBQ) and the Child Behavior Checklist (CBCL), filled out three times between the ages of 11 and 17.

Results

Male gender, low birth weight, low level of education of the mother, social, behavioral, language, psychomotor and eating problems significantly predicted ASD problems (odds ratios (OR) between 1.34-2.41). ADHD problems were also predicted by male gender and low level of education of the mother and by maternal smoking during pregnancy, good gross motor skills in first year, early attention hyperactivity problems, and absence of parent-reported positive behavior (ORs between 1.36-1.74).

Conclusions

Routine data on early childhood from PCH services are predictive for ASD and ADHD problems in adolescents in the general population. The PCH services are a useful setting to identify high risk groups, and to monitor them subsequently.

Introduction

Autistic spectrum disorders (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) are neurodevelopmental disorders with an onset early in life, with a prevalence of around 1% and 5%, respectively.[1,2] ASD and ADHD often co-exist. Estimates on overlap in children with ASD range from 28% to 53%; ASD problems in children diagnosed with ADHD are also very common, although precise estimates are lacking.[1-7] A recent study showed that a complex longitudinal pattern exists between social-communication and hyperactivity-inattentive traits. The majority of children with persistent hyperactive-inattentive symptoms also showed persistent social-communication deficits but not vice versa.[2] Recently the field has broadened its focus so that it now views ASD and ADHD as constituting the very severe end of continuous distributions in the general population.[8-10] Less severe variants of ASD and ADHD below the threshold for a diagnosis seem common, as shown by both family studies and studies in the general population.[8,9,11,12] We further denote these as ASD and ADHD problems. Individuals with these subthreshold problems have similar but milder impairments in social functioning, communication, and information processing relative to children with a clinical diagnosis.[8,11-14] Thus, even at subthreshold level, problems may be an important burden for the children themselves, their parents, and others in their environment which may be alleviated by treatment.

Research has shown that early identification of ASD and ADHD, if followed by adequate intervention, may improve prognosis.[15-18] It seems important to identify, monitor and, if necessary, intervene in these developmental problems as early as possible. Community pediatric services, such as those in the USA and Europe, are in a unique position for early identification of developmental problems in children. Early indicators are needed to monitor high risk groups (who very likely will develop additional problems or impairments), but there is a dearth of evidence on these in the general population. For clinically referred children with ASD or ADHD, however, several early indicators have been reported in the literature; these concern pre- and perinatal factors,[19-25] early behaviors and emotions,[25-30] motor and speech problems[31-33] and on atypicalities in regulation functions including sleeping and eating.[34-36] The age of observation of these indicators varies, and fluctuates between six months and three-and-a-half years.[18,30]

The aim of the present study is to identify early indicators of high risk groups for ASD and ADHD problems based on routine data from community pediatric services between infancy and age four. The present study is complementary to previous prospective work in that it is the first to focus on the general community by using data from routine Preventive Child Healthcare (PCH) measurements, and from birth up to age four. The presence of ASD and ADHD problems was assessed during (pre)adolescence. Note that previous studies on early indicators were focused on either ASD or ADHD. Given frequent co-occurrence[1,3-5,7] and evidence of overlapping early indicators when the separate literatures on ADHD and ASD are brought together, their simultaneous study may further our insight into which indicators are

unique to these disorders and which might be viewed as generic indicators for both. For the purpose of early detection and treatment, this is highly relevant.

Methods

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch (pre)adolescents.[37,38] Children with mental or physical incapability were excluded or because of language problems of the parents. The present study involves data from the first (n=2230, mean age=11.09, SD=0.56, starting March 2001), second (n=2149, mean age=13.55, SD=0.54) and third wave (n=1819, mean age=16.26, SD=0.73), and also involves data from the PCH files. Parents of 2139 (96%) children gave written informed consent to retrieve their child's file from the PCH at T1. Out of these, 84.9% could be traced (n=1816 PCH files). Children with and without a PCH file differed in parent-rated ASD (M=5.45, SE=0.13 for the retrieved and M=7.25, SE=0.36 for the non-retrieved, $p<0.001$, i.e. higher scores among the non-retrieved) and ADHD problems (M=3.83, SE=0.08 vs. M=4.41, SE=0.19, respectively, $p<0.01$) at T1. Both for ASD and ADHD problems, higher scores indicate more symptoms. The TRAILS study was approved by the national ethical committee 'Central Committee on Research involving Human Subjects'.

The outcome measures: ASD and ADHD problems

Parents filled out the Children's Social Behavior Questionnaire (CSBQ) and the Child Behavior Checklist (CBCL) at all three measurement waves. The CSBQ is a validated questionnaire for child social problems typically seen in children with ASD, especially in its milder forms, for ages 4-18.[39] The sum of the subscales of social interest, social understanding, stereotyped behavior, and resistance to change was used, which captures the core symptoms of ASD and consists of 30 items.[40] The CBCL is an internationally validated questionnaire for child emotional and behavioral problems for ages 4-18 and consists of 118 items.[41] From this questionnaire we used the DSM-IV-oriented attention hyperactivity problem scale as outcome measure. This scale consists of seven items.

Early indicators

In the Netherlands, PCH services provide health and developmental monitoring for all Dutch children from birth until age 19; the participation rate is over 90%. The information on indicators had been collected by community physicians and nurses (PCH professionals) as part of the routine procedure of the PCH. These assessments included a general physical examination, standardized screening procedures and an interview with parents concerning health status and developmental (physical, emotional and behavioral) problems, which were all documented in the PCH file. An assessment takes approximately 10 to 15 minutes. In accordance with the literature we selected all potentially relevant predictors: pre- and

perinatal factors, BMI and head circumference growth curves, psychomotor factors, early childhood behaviors, and sociodemographic variables from the PCH file.

Pre- and perinatal variables

Pre- and perinatal variables concerned maternal smoking and alcohol use during pregnancy, low birth weight (registered in grams) and birth defects as provided by the obstetrician or midwife. Maternal smoking and alcohol use were assessed as: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?" These questions were part of the PCH files, but were also part of the T1 interview in TRAILS (when a child was age 11 years). If either answer was "yes," we defined a score as indicative of smoking or alcohol use, respectively. The obstetrician or midwife could report yes or no, and in case of yes the amount per week or day. Often only yes or no was filled out, so more detailed information on quantity could not be retrieved. Low birth weight was defined as < 2500 grams, which is the standard clinical cut-off point. Birth defects included limb deformities, craniofacial malformations and anomalies in organs, which are often seen in children with a clinical diagnosis of autism.[9] Respondents received a "yes" if any of these were present and a "no" if none were present.

BMI and head circumference increase

BMI at age 2, 3 and 4 years (extracted from weight and height in the PCH files) was categorized into: low BMI, intermediate BMI and high BMI; gender and age-specific cut-offs were used.[42,43] Head circumference increase, from birth until age six months and from age six months until 12 months, was standardized into Mean Z-scores,[44] and then dichotomized into the highest 10% versus the rest.

Psychomotor development

Psychomotor development from birth to age four was assessed by three indices. The first was the Van Wiechen Scheme designed for children aged between one month and 15 months, which is the Dutch equivalent of the Bayley scales.[45] The PCH professional assigns a pass or fail score to each indicator for a given child. Indicators are divided into three different subcategories: gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items); each is targeted at children of a certain age. Items within these three subcategories are summed to provide subscales.

The second index concerned psychomotor development from the age of 18 months until four years old, with six measurements in this period, and was assessed as: "Does the child have any problems with motor skills and/or with speech and language" with both reported by either a "yes" or "no". Motor skills, and speech and language, were each added up, respectively, and then dichotomized to a "yes" if any of these were present during these six occasions, and a "no" if none were present.

The third index concerned neurological problems observed during physical examination of the child, conducted six times between the ages of 18 months and four years old. If on any occasion a problem was present, this index was coded as "yes", and as "no" if none were present.

Early childhood behavior

Early childhood behavior refers to behavioral features which were the most striking in the child and were recorded between ages 1.5 to 4 years, for which we distinguished "sleeping, eating and emotional and behavioral problems." During PCH visits, the PCH professional inquired into these problems as: "How is your child doing as far as eating is concerned?" and "How is your child doing as far as sleeping is concerned?" Difficulties such as "has problems falling asleep", "wakes up and can't sleep afterwards", "eats with much problems" or "eats very little" were reported. Descriptions of these behaviors were categorized as "yes," in case of problems, and "no" or "missing." The responses to the six times that these behaviors were probed were added up, and then dichotomized to a "yes," if any of these were present, and a "no," if none were present. "Emotional and behavioral problems" were collected from three open questions in the PCH files, that is, "How does the child play," "How is the child's behavior?" and "How is the child's social behavior?" The community physician or the nurse could report difficulties here such as "overactive," "shy," "anxious" or "aggressive," but also strengths such as "social" (see Table 1). These PCH-registered descriptions were categorized as social problems in behavior, attention hyperactivity problems, internalizing problems, externalizing problems or absence of parent-reported positive behavior and then dichotomized to a "yes" if any of these were present during these six occasions, and a "no" if none were present.

Sociodemographic variables

Sociodemographic variables refer to the highest educational level of the father and the highest educational level of the mother. We have distinguished two groups here: low (lower tracks of secondary education or less), and middle and high (higher tracks of secondary education, and university degree or more) educational levels, respectively.

Statistical analysis

Prior to analyses, both outcome measures (CSBQ and CBCL) were dichotomized. To determine the optimal cut-off point for dichotomization for both questionnaires, we plotted the cumulative score distribution of decentile scores (x-axis) versus raw scores (y-axis). All graphs showed steep increases in problem behavior with a consistent kink at the 80th percentile. From that point onwards children began to have substantially more problems. For the CSBQ, the kink at the 80th percentile was at 9 for all three measurements; for the ADHD

Table 1. Description of behavior of children by PCH professionals divided into five categories

Social problems in behavior	Attention hyperactivity problems	Emotional problems	Behavioral problems	Positive behavior
Cannot be made enthusiastic about things	Boisterous	Anxious	Aggressive	Affectionate
Cannot stand change	Concentration problems	Clings to mother	Argues a lot	Attentive
Child with a "manual"	Difficulty concentrating during play	Cries easily	Argumentative	Cheerful
Difficulties getting used to new situations	Distracted / hyperactive	Easily frightened	Behavioral problems	Confident
Difficulty getting used to others	Dreamy	Fear of abandonment	Bites others	Cool, composed
Does not like many things happening simultaneously	Easily bored	Fear of failure	Bold	Cooperative
Does not respond to initiatives by others	Impulsive	Insecure	Defiant	Cuddly
Easily manipulated	Jumps from one thing to another	Introvert	Demands attention in a negative way	Curious
Head banging	Noisy	Nervous	Disobedient	Cute
Hits him/herself	Pushes the limits	Over-sensitive	Flings toys	Eager to learn
Immature	Reacts to everything and everyone	Over-submissive	Gets "beside him/herself"	Easy
Inappropriate play	Restless	Panics easily	Harassing	Enthusiastic
Needs very strict routines	Sees no danger	Quiet	Headstrong	Flexible
Peculiar child	Short attention span	Separation anxiety	Hits others	Focused
Resists new things	Talks excessively	Shy	Impatient	Helpful
Social interaction does not extend beyond caretakers	Turbulent	Silent	Impertinent	Independent
Sometimes hard to connect with	Very active	Timid	Imposing	Interested
Withdrawn	Volatile	Worried	Kicks others	Kind
	Wild		Manipulative	Lively
			Moody	Looks after others
			Nagging	Nice
			Oppositional	Open
			Overly present	Patient
			Provocative	Picks up on things easily
			Quickly becomes angry	Polite
			Rebellious	Rich imagination
			Stubborn	Sociable
			Temper tantrums	Social
			Whining	Spontaneous
				Sweet
				Takes the initiative

scale of the CBCL it was 7. We defined a score above the 80th percentile at least twice (out of three measurements) as indicative of the presence of ASD and ADHD problems.

Subsequently we calculated descriptive statistics for all predictor variables and performed logistic regression analysis to examine the influence of early development on ASD and ADHD behaviors. Based on the results of the univariate analyses, we considered variables associated with the outcomes at $p<0.2$ to be candidates for multiple logistic regression analyses. Variables were entered into a backward stepwise logistic regression procedure, generating a subset of independent predictors for the two outcome measures. As a final step, we investigated whether our final multivariate models changed when we brought the presence of ASD problems into the equation for predicting ADHD problems and vice versa; this to determine whether identified indicators were generic or specific to these problems. Statistical analyses were performed using SPSS Windows version 16.

Results

Out of our overall sample (n=1816), 348 adolescents met the ASD criterion and 419 fulfilled the ADHD criterion. One hundred and ninety-six met both ASD and ADHD criteria. Descriptive statistics of predictor variables in the ASD and ADHD groups, as well as in the remainder of the total sample, i.e. those who are not in either the ASD or the ADHD group , are presented in Table 2. The Mean of the CSBQ was 5.5 at T1 (SD=5.6), 5.1 at T2 (SD=5.8) and 5.0 at T3 (SD=5.7). The Mean of the CBCL was 3.8 at T1 (SD=3.1), 2.8 at T2 (SD=2.7) and 2.5 at T3 (SD=2.6).

Table 3 gives the crude and multivariate odds ratios (OR), and the 95% confidence intervals, on the predictors for ASD and ADHD problems on the CSBQ and the CBCL. Male gender, a low level of education of the mother, a low birth weight, language, psychomotor and eating problems, and social problems (all at toddler age) were identified as significant independent determinants of ASD problems on the CSBQ. A low level of education of the father, maternal smoking during pregnancy, head circumference increase (0-6 months), low BMI at age 2, sleep problems and absence of parent-reported positive behavior did not contribute to the model as independent predictors in multivariate analyses. Controlling for ADHD problems in the ASD group left the model virtually unchanged, only a low level of education of the mother dropped below significance levels, with small reductions in OR. The OR for the presence of ADHD problems was substantial (Table 3).

For ADHD problems on the CBCL, male gender, a low level of education of the mother, maternal smoking during pregnancy, gross motor skills (during the first year), attention hyperactivity problems, and absence of parent-reported positive behavior (at toddler age) were determinants. A low level of education of the father, sleep problems, problems with eating and externalizing problems did not contribute to the model as independent predictors in multivariate analyses. Controlling for ASD problems in the ADHD group left the model nearly intact; only maternal smoking during pregnancy and the absence of parent-

reported positive behavior dropped below significance levels, with small reductions in ORs. The OR for the presence of ASD problems was substantial (Table 3).

Table 2. Scores on early indicators in Autism Spectrum Disorder (ASD) and Attention Deficit/Hyperactivity Disorder (ADHD) groups and the remainder of the sample

Indicators from PCH file	ASD group n= 348 n (%)	ADHD group n= 419 n (%)	Remainder of the sample n= 1245 n (%)
Boys	215 (61.8%)	253 (60.4%)	543 (43.6%)
Low education of mother	141 (40.5%)	179 (42.7%)	332 (34.2%)
Low education of father	110 (31.6%)	125 (29.8%)	339 (27.2%)
Maternal alcohol use during pregnancy	66 (19%)	94 (22.4%)	247 (19.8%)
Maternal smoking during pregnancy	124 (35.6%)	158 (37.7%)	365 (29.3%)
Low birth weight (< 2500 grams)	26 (7.5%)	24 (5.7%)	60 (4.8%)
Birth defects	7 (2.0%)	7 (1.7%)	27 (2.2%)
Neurological abnormalities (0- 4 yrs.)	15 (4.3%)	25 (6.0%)	63 (5.1%)
Head circumference increase (0- 6 mos.)	39 (11.2%)	35 (8.4%)	94 (7.6%)
Head circumference increase (6-12 mos.)	27 (7.8%)	25 (6.0%)	76 (6.1%)
Low BMI at age 2	45 (12.9%)	44 (10.5%)	143 (11.5%)
Low BMI at age 3	3 (0.9%)	8 (1.91%)	13 (1.0%)
Low BMI at age 4	2 (0.6%)	1 (0.2%)	15 (1.2%)
Van Wiechen Scheme (VWS): gross motor skills (1-15 mos.)	72 (20.7%)	59 (14.1%)	261 (21.0%)
VWS: fine motor skills and adaptation (1-15 mos.)	29 (8.4%)	26 (6.2%)	83 (6.7%)
VWS: communication and social behavior (1-15 mos.)	30 (8.6%)	36 (8.6%)	81 (6.5%)
Language difficulties (1.5- 4 yrs.)	32 (9.2%)	30 (7.2%)	74 (5.9%)
Psychomotor difficulties (1.5- 4 yrs.)	25 (7.2%)	19 (4.5%)	44 (3.5%)
Sleep problems (1.5- 4 yrs.)	105 (30.2%)	126 (30.1%)	287 (23.1%)
Problems with eating (1.5- 4 yrs.)	196 (56.3%)	232 (55.4%)	604 (48.5%)
Social problems in behavior (1.5- 4 yrs.)	38 (10.9%)	35 (8.4%)	79 (6.3%)
Attention hyperactivity problems (1.5- 4 yrs.)	133 (38.2%)	203 (48.4%)	421 (33.8%)
Externalizing problems (1.5- 4 yrs.)	146 (42.0%)	190 (45.3%)	446 (35.8%)
Internalizing problems (1.5- 4 yrs.)	66 (19.0%)	64 (15.3%)	217 (17.4%)
Absence of parent-reported positive behavior (1.5- 4 yrs.)	176 (50.6%)	206 (49.2%)	507 (40.7%)

Table 3. Associations of Preventive Child Healthcare indicators with ASD and ADHD problems: odds ratios and 95% confidence intervals (CI)

	ASD group (n=348)			ADHD group (n=419)		
	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (adj)[b] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (adj)[b] 95% CI
Boys	**1.71 (1.39-2.11)**	**1.87 (1.43-2.45)**	**1.63 (1.27-2.17)**	**1.75 (1.43-2.13)**	**1.74 (1.38-2.19)**	**1.41 (1.08-1.85)**
Low education of mother	**1.65 (1.28-2.13)**	**1.45 (1.12-2.11)**	1.40 (0.96-2.03)	**1.74 (1.37-2.21)**	**1.52 (1.15-2.01)**	**1.45 (1.01-2.08)**
Low education of father	**1.48 (1.15-1.90)**			**1.59 (1.25-2.02)**		
Maternal alcohol use during pregnancy	0.96 (0.74-1.24)			1.10 (0.86-1.40)		
Maternal smoking during pregnancy	**1.24 (1.01-1.54)**			**1.60 (1.30-1.96)**	**1.36 (1.07-1.73)**	1.31 (0.99-1.75)
Low birth weight	**1.67 (1.05-2.67)**	**1.93 (1.14-3.27)**	**1.95 (1.10-3.48)**	1.13 (0.70-1.82)		
Birth defects	0.97 (0.42-2.24)			0.75 (0.33-1.72)		
Neurological abnormalities	0.78 (0.45-1.38)			1.22 (0.76-1.96)		
Head circumference increase (0-6 mos.)	**1.50 (1.04-2.26)**			0.91 (0.61-1.35)		
Head circumference increase (6-12 mos.)	1.38 (0.88-2.12)			1.07 (0.50-2.31)		
Low BMI at age 2	**1.54 (1.10-2.20)**			1.03 (0.74-1.44)		
Low BMI at age 3	1.07 (1.01-1.14)			2.59 (0.94-7.13)		
Low BMI at age 4	0.66 (0.13-3.48)			0.24 (0.03-2.05)		
Van Wiechen Scheme gross motor skills	0.94 (0.70-1.25)			**0.73 (0.61-0.88)**	**0.59 (0.44-0.80)**	**0.60 (0.42-0.87)**
VWS fine motor skills	1.30 (0.85-2.01)			0.88 (0.56-1.38)		
VWS communication	1.27 (0.83-1.94)			1.28 (0.86-1.91)		
Language difficulties	**1.61 (1.05-2.46)**	**1.75 (1.09-2.81)**	**1.71 (1.02-2.87)**	1.15 (0.75-1.77)		
(Psycho)motor difficulties	**2.22 (1.35-3.65)**	**2.41 (1.38-4.17)**	**2.60 (1.42-4.76)**	1.16 (0.68-1.99)		
Sleep problems	**1.37 (1.06-1.78)**			**1.31 (1.05-1.63)**		
Problems with eating	**1.33 (1.05-1.69)**	**1.34 (1.02-1.73)**	**1.28 (1.02-2.87)**	**1.38 (1.08-1.76)**		
Social problems in behavior	**1.84 (1.23-2.73)**	**1.65 (1.04-2.60)**	**1.73 (1.06-2.84)**	1.25 (0.83-1.88)		
Attention hyperactivity problems	1.10 (0.86-1.40)			**1.95 (1.56-2,43)**	**1.71 (1.35-2.16)**	**2.04 (1.55-2.69)**
Externalizing problems	1.22 (0.96-1.55)			**1.47 (1.18-1.84)**		
Internalizing problems	1.16 (0.86-1.56)			0.82 (0.61-1.11)		
Absence of parent-reported positive behavior	**1.43 (1.13-1.81)**		1.24 (0.93-1.65)	**1.36 (1.09-1.70)**	**1.36 (1.06-1.75)**	1.25 (0.95-1.64)
ADHD or ASD problems in adolescence			**6.48 (4.85-8.66)**			**6.85 (5.10-9.20)**

Criterion p<0.2 for inclusion in multiple logistic regression model

[a]adj = adjusted for all other variables which are included in the multiple logistic regression model

[b]adj = adjusted for all other variables which are included in the multiple logistic regression model including ADHD problems in ASD groups and vice versa

Discussion

This study was the first to use early childhood findings as registered by community pediatric services to predict ASD and ADHD problems in adolescents in a large longitudinal community-based sample. We identified several early childhood indicators predictive of ASD and ADHD problems. Male gender and low level of education of the mother were generic indicators, while a low birth weight, social behavioral problems, language, and psychomotor and eating problems at toddler age were specific for ASD problems, and maternal smoking during pregnancy, gross motor skills during infancy, and attention hyperactivity problems at toddler age, for ADHD problems.

We found two important results that warrant further comment. Both controlling for ADHD problems in the ASD group and controlling for ASD problems for the ADHD group did leave the model virtually unchanged and vice versa, while the OR for the presence of ASD and ADHD problems was substantial. This indicates that neither risk indicators for ASD nor risk indicators for ADHD can be attributed solely to the shared variance between ADHD and ASD, therefore, early developmental risk indicators are to some extent specific for ASD and ADHD.

A second intriguing result was that early attention hyperactivity problems were predictive for later ADHD problems but not for ASD problems, while early social problems in behavior were predictive for later ASD problems but not for ADHD problems. In contrast, during adolescence ADHD is predictive for ASD and vice versa.[2] This finding points to specificity of risk indicators measured very early in development.

Our study adds important information because of our approach to use PCH data regarding the general community which differs from previous studies on early indicators of ASD or ADHD. Previous studies on ASD focused on clinically-referred and selective high-risk children, such as siblings of children with ASD.[29,32,34] Previous studies about early indicators of ADHD are scarce, and none of them was based on prospectively collected data to a younger age than 2 years.[25,33] The prospective and community-based nature of our study thus adds important information to what was already known.

Importantly, none of these studies used data from the PCH services, even though these services routinely follow the physical (diseases and growth) and psychosocial development of all children from birth on, in addition to screening for different disorders. Moreover, PCH services collect and register data according to a highly standardized format, including a number of objective parameters (e.g., birth weight, BMI, head circumference), therefore providing an outstanding setting for studying risk indicators in unbiased samples.

Given our focus on the general community, it is important to note that we identified largely the same early indicators as have been reported for referred and selected high risk ASD and ADHD samples, i.e. pre- and perinatal factors,[25] early behavioral signs associated with ASD including impairments or delay in social-communicative development,[26,29] early behavioral signs such as hyperactive-impulsive and inattentive temperamental features,[25,27]

motor, language and speech development,[31-33] atypicalities in regulation functions related to eating[36] and family adversity.[46] This suggests that findings from selected samples may be generalized to community-based samples and vice versa, and emphasizes how useful the PCH setting can be for identifying and monitoring both subthreshold and clinical ASD and ADHD.

The major strength of our study is the uniqueness of its design: its prospective nature, spanning many years from birth on, and its embedding in a routine PCH setting. Another strength is that we studied ASD and ADHD problems in tandem, therefore the first to report on generic and specific early childhood indicators. A further strength is our use of multiple indicators of varying types, as previous ASD or ADHD studies only used subsets of indicators. Recent overviews have shown that in most prognostic studies single rather than multiple indicators are investigated, but that multiple indicators provide better models.[47,48] A final strength of this study is that the identification of ASD and ADHD problems was based on three ratings, each two-and-a-half years apart, thus reducing measurement error. Also, TRAILS constitutes a large sample with a high response rate, and we retrieved PCH files for the large majority of the participants.

Our study also has limitations, but insofar as these may have affected our results, they will all lead to underestimation of the predictive power of the PCH findings. First, children may have received effective treatment for their developmental problems between the ages of 4 and 11. Second, children in our sample had a lower mean score on ASD and ADHD problems than the remainder of the sample for whom PCH files could not be retrieved, and also, as a result of the design of TRAILS, there were no cases of ASD with severe mental retardation in our study, while ASD problems are common in these children.[49,50] A related third issue is that some highly predictive early risk indicators are low prevalent and thus were not identified as indicators due to their low prevalence. This may, for instance, concern birth defects. Moreover, for some early risk indicators we lacked detailed information, for example, we knew if the mother smoked during pregnancy but not the daily dose of cigarettes. A final limitation may be that we did not use semi-structured interviews. Previous studies, in particular where ASD is concerned, used (semi-)structured interviews which are less susceptible to measurement error and interpretational bias. However, a gold standard interview such as the Autism Diagnostic Interview is designed to pick up on only the severe cases within ASD and is of no use in the general population. Note that part of the measurement error was removed by repeated measurement of ASD and ADHD problems.

In conclusion, the community pediatric services are a useful setting for both research on early predictors of ASD and ADHD problems in unbiased samples and for the early detection of children at risk in routine care. From early childhood PCH-registered routine data of a large community based sample we identified largely the same early indicators of ASD and ADHD problems as have been reported for clinically referred ASD and ADHD samples. This shows that routine PCH can identify children at risk of both sub-threshold and clinical ASD and ADHD in early childhood. The community pediatric services may also play an important role

in close monitoring of children identified in such a way, by administering in depth diagnostic instruments to further qualify their symptoms, and by providing early treatment if needed. Notwithstanding relatively modest differences, this may have a rather huge public health impact as these services cover the full population of children.

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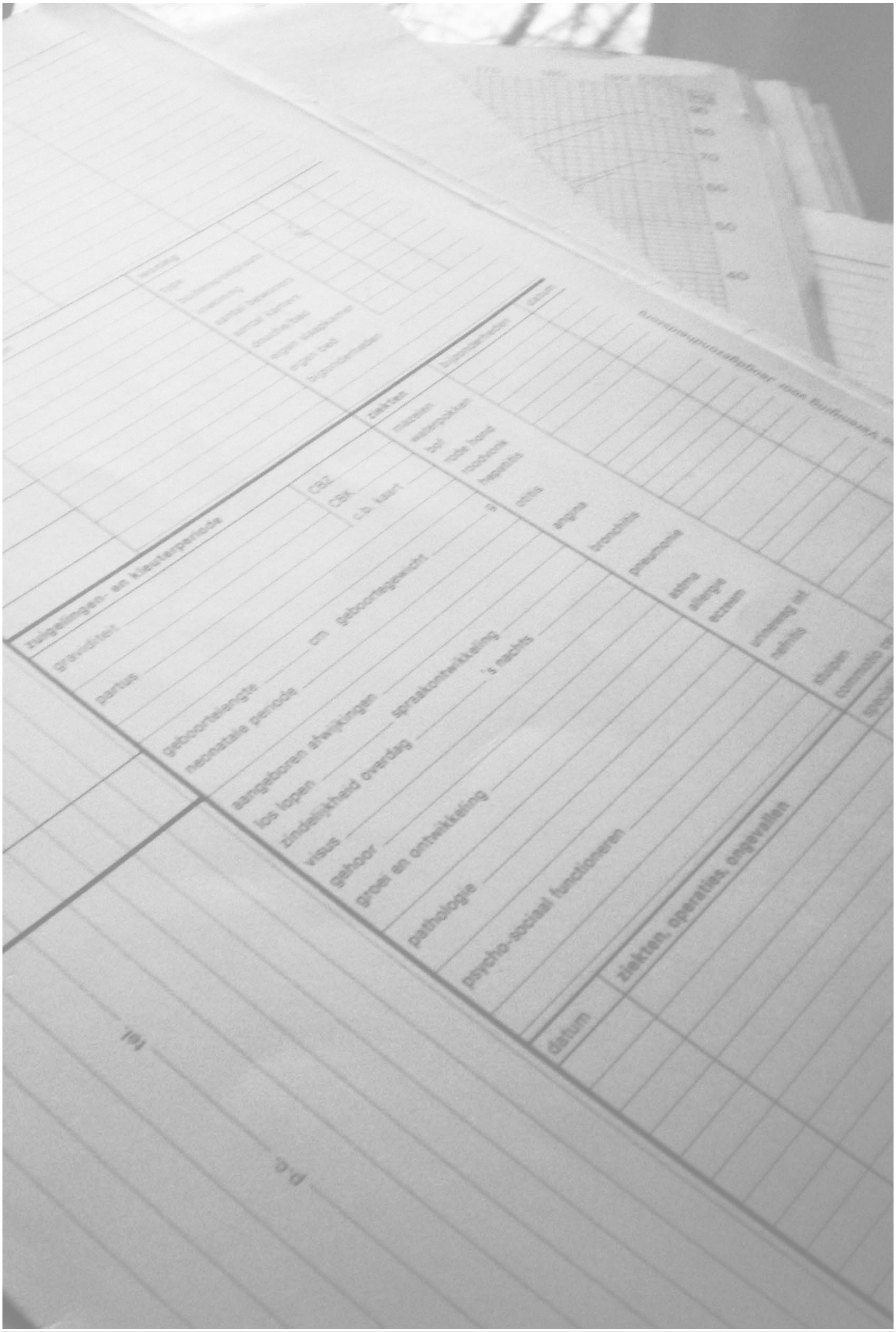
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Preventive child healthcare findings on early childhood predict peer-group social status in preadolescence

M. Jaspers
A. F. de Winter
R. Veenstra
J. Ormel
F. C. Verhulst
S. A. Reijneveld

Submitted

Abstract

Purpose

A disputed social status among peers puts children and adolescents at risk for developing a wide range of problems such as being bullied. However, there is a lack of knowledge about which early predictors could be used to identify (young) adolescents at risk for a disputed social status. The aim of this study is to assess whether preventive child health care (PCH) findings on early childhood predict neglected and rejected status in preadolescence in a large longitudinal community-based sample.

Methods

Data came from 898 participants who participate in TRacking Adolescents' Individual Lives Survey (TRAILS), a longitudinal study. Information on early childhood factors was extracted from the charts of routine PCH visits registered between infancy and age four. To assess social status, peer nominations were used at age 10-12.

Results

Multinomial logistic regression showed that children who had a low birth weight, motor problems, sleep problems, and that children from parents with a low educational level (odds ratios (OR) between 1.71 and 2.90) and with less attention hyperactivity problems (ORs 0.43) were more likely to have a neglected status in preadolescence. Boys, children from parents with a low educational level, and children with early externalizing problems were more likely to have a rejected status in preadolescence (ORs between 1.69 and 2.56).

Conclusions

PCH findings on early childhood – on motor and social development – are predictive of a neglected and rejected status in preadolescence. PCH is a good setting to monitor social status of young adolescents.

Introduction

Having a disputed social status among peers puts children at risk for a wide range of subsequent problems including being bullied,[1-3] mental health problems,[4-7] academic difficulties, or school dropout.[5,6,8,9] As for disputed social status, usually two types are distinguished: rejected and neglected children.[10,11] Both groups score low on peer acceptance. The difference between the two groups is their level of peer rejection. Rejected children are disliked by their peers. Neglected children score low on peer rejection; they are scarcely noticed by their peers. Given the negative consequences of having a neglected or rejected status, it is important to identify which factors precede this disputed social status.

It has been shown that sociodemographic and psychological factors can predict a neglected and rejected status. Evidence shows that belonging to a family with a low socioeconomic status is predictive for a disputed social status.[12,13] Being aggressive,[13,14] hyperactive, less social, and having a poorer academic performance in elementary school are also predictors.[12,13] Other studies focused on the impact of early temperament on a disputed social status in kindergarten and early elementary school.[15-17] Less is known about the potential role of developmental delays such as motor or language problems.[18] Determinants of developmental delay such as a low birth weight may also be associated with a disputed social status; so far, however, no studies have looked into this. Evidence on the joint effect of early risk factors for a disputed social status is limited. The above-mentioned early risk factors are factors that are distinctive and noticed by the social environment, especially among peers.

Identification of children and adolescents at risk for a disputed social status could lead to earlier interventions designed to improve social skills, social acceptance, and self-esteem, and to prevent the negative outcomes associated with having a neglected or rejected status. This can be achieved by measuring a range of potential risk factors from multiple domains and by starting before peer relationships are well established. These factors are routinely assessed in preventive child healthcare (PCH) during well-child visits.

The aim of the present study is to assess whether PCH findings on early childhood predict social status in preadolescence in a large longitudinal community-based sample. This study is the first to use a wide range of early childhood factors found in routine PCH measurements to predict neglect and rejection by peers in such a sample. In the Netherlands, PCH provides health and developmental monitoring to all Dutch children from birth until age 19, and the participation rate is over 90%.[19] Dutch PCH professionals are highly trained and experienced in registering those child and family characteristics that are relevant for current and future development.

Methods

Sample

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch adolescents beginning at 10-12 years of age that focuses on adolescent psychosocial development and mental health in the general population.[20,21] The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities in the northern part of the Netherlands. Of all the young adolescents approached for enrolment in the study (n=3145), 6.7% were excluded because of mental or physical incapability, or if no Dutch-speaking parent or parent surrogate was available. Seventy-six percent of the remaining 2935 young adolescents (n=2230, mean age=11.1, SD=0.6, 50.8% girls) and their parents agreed to participate. For detailed descriptions of sample selection procedures and non-response analyses, see De Winter et al.[21]

The present study consists of a subsample of 898 of the 2230 TRAILS participants (mean age=11.0, SD=0.51), for whom both information on social status and PCH files were available. Information on social status was supplied by peers. These peer nominations, which were essential to our study, were only assessed in classrooms with at least 10 TRAILS participants. The subsample of 898 young adolescents differed from the other TRAILS participants mainly as to type of education; young adolescents in special education were not included. For a detailed description, see Veenstra et al.[22] All procedures were approved by the Dutch Central Committee on Research Involving Human Subjects ("CCMO").

Preventive child health care setting

The aim of the PCH is prevention and early identification through a semi-structured interview with parents and standardized screening procedures, all of which are documented in the PCH file. An assessment generally takes 10 to 15 minutes. During children's first four years, community physicians and nurses record data on early childhood indicators at each visit as part of the routine procedure of the PCH, with a total number of 12 visits.

The outcome measurement: social status

Social status was assessed with peer nominations at age 10-12. Young adolescents received a list of all classmates and were asked to answer the following questions: "Who do you like?" and "Who do you dislike?". Young adolescents could make an unlimited number of nominations. On the basis of the received like and dislike nominations, two sociometric variables were computed: social preference and social impact. Social preference was calculated by subtracting the standardized dislike score from the standardized like score. Social impact was calculated by adding the standardized like score and the standardized dislike score.[6] For this study, we focused on the adolescents that were classified as: (a) rejected – low on social preference (< -1 SD), and above average on (> 0 SD) dislike and

below average on (< 0 SD) like; or (b) neglected – low on social impact (< -1 SD) and below average on both dislike and like (< 0 SD) versus the other young adolescents (i.e., popular, average, and controversial).[6] The controversial adolescents are included among the popular and average adolescents because they are liked and accepted by part of their group, and hence are not in the same disputed social position.

PCH-assessed early childhood indicators

As potential indicators, we selected PCH-assessed prenatal and perinatal variables, as well as early motor and social development, and family characteristics.

Prenatal and perinatal variables

Maternal smoking and alcohol use were assessed as: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?" If these data were missing from the PCH file, then we imputed data from the T1 interview on this topic.

Low birth weight was defined as < 2500 grams, which is a frequently used clinical cut-off point.[23] Birth defects included limb deformities and craniofacial malformations. Respondents received a "yes" if any of these were present and a "no" if none were present.

Early motor and social development

Early motor and social development, from birth to four years of age, was assessed by four indices. The first was the Van Wiechen Scheme, from age one month to 15 months, which is the Dutch equivalent of the Bayley scales.[24] Indicators were divided into three different subcategories, gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items), each targeted at children of a certain age. Items within these three subcategories were summed to provide subscales.

Second, the PCH professional assessed (also based on parental reports) motor and language development, six times from age 18 months to four years, and reported as either "yes" in case of a problem, or "no". Motor and language skills were each added up, respectively, and then dichotomized to a "yes" if any problems were present during these six occasions, or to a "no".

Third, from age 18 months to four years, the PCH professional assessed the development of sleeping and eating behavior six times. Descriptions of this behavior were categorized as "yes", in case of problems, or "no". The responses to this behavior were added up, and then dichotomized to a "yes", if any problems were present, and a "no", if none were present.

Fourth, PCH assessed a number of behavioral features which were recorded on six occasions between the ages of 18 months to four years. These behavioral features were collected from three open questions concerning playing, problem behavior, and social behavior, about which parents could provide one or more descriptions. Descriptions included, for example, overactive, shy, anxious, or aggressive.[25] PCH-registered descriptions

were categorized as externalizing problems, internalizing problems, attention hyperactivity problems, or social problems in behavior, and then dichotomized to a "yes" if any of these were present during these six occasions, and to a "no" if none were present.

Family characteristics

Maternal age at the birth of the child (mean=29.4, SD=4.5 years) was dichotomized to contrast young mothers (age 20 and younger) with older mothers. We distinguished three groups for educational level of parents: low (at the lowest tracks of secondary education), middle (higher tracks of secondary education), and high (higher vocational or university degree) educational level, respectively. The highest level of education of one of the parents was taken as the educational level of the parents. Structural family characteristics consisted of two groups: living with both biological parents versus divorced parents, stepparent(s), or single-parent households.

Statistical analysis

First, descriptive statistics were calculated for social status and early childhood indicators. Second, to assess the longitudinal relationship between early childhood indicators and current social status, multinomial logistic regression analysis was used. The multinomial logistic model (MNLM) can be used to examine the effects of independent variables on multi-category dependent variables, referring in this case to neglected, rejected, and other young adolescents. With three outcomes, the MNLM is roughly equivalent to running three binary logistic regressions. In the MNLM, all of the logits are estimated simultaneously, which enforces the logical relationship among the parameters and uses the data more efficiently.[26] If the chi-square tests showed statistically significant ($p<.05$) differences among the three groups, then we assessed the crude effect of each variable separately on the outcomes. Next, we assessed the multivariate (mutually adjusted) effects of all variables that attributed univariately with statistical significance ($p<.05$).

Results

Table 1 shows the differences between neglected, rejected, and other adolescents for PCH-registered prenatal and perinatal factors, early motor and social development factors, and family characteristics. Of the 898 adolescents, 13.8% were in the neglected group, and 12.1% were in the rejected group. In comparison with the other adolescents (i.e., average, controversial, and popular adolescents), during early childhood neglected adolescents more often had a low birth weight, motor problems, sleep problems, attention hyperactivity problems, and parents with a lower level of education ($p<.10$). Adolescents in the rejected group were more often boys, had more communication delays (age 1-15 months), and showed more externalizing and attention hyperactivity problems. Furthermore, they had younger mothers, more often mothers who smoked during pregnancy, less often mothers

who used alcohol during pregnancy, parents with a lower level of education, and they came less often from intact families compared to the other adolescents (*P* values all below 0.10).

Table 2 gives multivariate odds ratios (and 95% confidence intervals) for PCH predictors for having a neglected or rejected status at age 11. A low birth weight, early motor problems, early sleep problems, having attention hyperactivity problems, and a low level of parental education were identified as significant independent predictors of a neglected status (ORs between 0.43 and 2.90) in the multinomial logistic regression model. Gender (being a boy) did not contribute to the model as an independent predictor. For a rejected status, being a boy, early externalizing problems, and a low level of parental education were predictors (ORs between 1.69 and 2.56). Maternal smoking and alcohol use during pregnancy, maternal age under 21 at the birth of the child, early communication delays, early attention hyperactivity problems, and family break-up did not significantly contribute to the model as independent predictors.

Discussion

This study was the first to assess the effects of PCH findings on early childhood in terms of having a disputed social status later on in preadolescence, using a large longitudinal community-based sample. We identified several early childhood indicators that predicted neglect and rejection by peers. Children with a low birth weight, early motor problems, early sleep problems, and children with parents with a low educational level were more likely to have a neglected status; children with early attention hyperactivity problems were less likely to be so. Boys, children with parents with a low educational level, and children with externalizing problems in toddlerhood were more likely to have a rejected status in preadolescence.

Our study shows that PCH findings on sociodemographic, developmental, and psychological aspects are important for predicting a disputed social status in preadolescence. First, having parents with a low educational level is predictive for both being rejected and neglected, which is in line with previous studies which found that a low socioeconomic status of the family predicted rejection.[13,27] These previous studies did not provide information as to its association with a neglected status, however. Second, our study shows that a low parental educational level, a low birth weight, and early motor problems also independently predict a neglected status.

Third, we found in our study that toddlers who showed impulsive, hyperactive, and disruptive behavior had a lower chance of neglect later in life. Cross-sectional studies found that neglected children and adolescents were less aggressive and disruptive.[11] Because of their lack of social behavior, most likely they are less visible in groups, putting them at risk of being ignored by their peers. Surprisingly, having early attention hyperactivity problems is not predictive for a rejected status at age 11, whereas Brendgen and colleagues[12] found that

Table 1. Background and developmental features of preadolescents at age 10-12 by social status

Variable	Total n (%)	Neglected (13.8%)	Rejected 12.1%)	Others (74.1%)	p values
Gender (boy)	398 (44.3%)	34.7%	63.3%	43.0%	***
Prenatal and perinatal factors					
Maternal alcohol use during pregnancy	115 (13.0%)	9.9%	5.6%	14.9%	*
Maternal smoking during pregnancy	257 (28.9%)	29.3%	37.4%	27.5%	*
Low birth weight (< 2500 grams)	39 (4.3%)	8.1%	5.5%	3.5%	*
Born premature (<37 weeks)	35 (3.9%)	5.6%	4.6%	3.5%	
Birth defects	17 (1.9%)	0.8%	3.7%	1.8%	
Early motor and social development					
Gross motor skills delay (age 1-15 mos.)	158 (17.6%)	19.4%	12.0%	18.2%	
Fine motor skills delay (age 1-15 mos.)	60 (6.7%)	8.9%	7.4%	6.2%	
Communication delay (age 1-15 mos.)	50 (5.6%)	7.3%	7.4%	5.0%	*
Motor problems (age 1.5 - 4 yrs.)	30 (3.3%)	7.3%	2.8%	2.7%	*
Language and speech problems (age 1.5 - 4 yrs.)	54 (6.0%)	7.3%	8.3%	5.4%	
Sleep problems (age 1.5 - 4 yrs.)	211 (23.5%)	31.5%	19.3%	22.7%	*
Problems with eating (age 1.5 - 4 yrs.)	451 (50.2%)	46.8%	48.6%	51.1%	
Externalizing problems (age 1.5 - 4 yrs.)	340 (37.9%)	34.7%	52.2%	35.9%	**
Internalizing problems (age 1.5 - 4 yrs.)	145 (16.1%)	22.6%	11.9%	15.6%	
Social problems in behavior (age 1.5 - 4 yrs.)	56 (6.2%)	4.0%	6.4%	6.6%	
Attention hyperactivity problems (age 1.5 - 4 yrs.)	324 (36.1%)	21.8%	48.6%	36.7%	***
Family characteristics					
Low educational level of parents	198 (22.0%)	28.7%	32.7%	19.5 %	*
Structural family characteristics	167 (18.6%)	15.3%	26.6%	17.9%	*
Mother under age 21 at birth child	28 (3.1%)	5.0%	6.9%	2.3%	*

n= 898, *** p<.001, ** p<.01, * p<.10 (two-tailed) chi-square tests

Table 2. Univariate and multivariate multinomial logistic regression on social status for preadolescents at age 10-12: Odds ratios, OR (and 95% confidence intervals, CI)

Variable	Neglected (13.8%)		Rejected (12.1%)		Others (74.1%)
	OR (crude) 95% CI	OR (adj*) 95% CI	OR (crude) 95% CI	OR (adj*) 95% CI	
Gender (boy)	0.70 (0.47-1.05)	0.80 (0.53-1.21)	**2.29 (1.50-3.47)**	**2.05 (1.32-3.17)**	1
Maternal alcohol use during pregnancy	0.56 (0.29-1.08)	-	**0.34 (0.14-0.79)**	-	1
Maternal smoking during pregnancy	1.09 (0.72-1.67)	-	**1.58 (1.03-2.42)**	-	1
Low birth weight (< 2500 grams)	**2.45 (1.14-5.28)**	**2.59 (1.16-5.75)**	1.63 (0.65-4.09)	1.83 (0.66-5.06)	1
Communication delay (age 1-15 mos.)	1.50 (0.70-3.22)	-	1.53 (0.69-3.41)	-	1
Motor problems (age 1.5 - 4 yrs.)	**2.81 (1.23-6.42)**	**2.90 (1.24-6.77)**	1.02 (0.30-3.51)	1.19 (0.33-4.23)	1
Sleep problems (age 1.5 - 4 yrs.)	**1.56 (1.03-2.39)**	**1.71 (1.09-2.68)**	0.81 (0.49-1.35)	0.67 (0.39-1.15)	1
Attention hyperactivity problems (age 1.5 - 4 yrs.)	**0.48 (0.31-0.76)**	**0.43 (0.26-0.69)**	**1.63 (1.09-2.45)**	1.43 (0.93-2.20)	1
Externalizing problems (age 1.5 - 4 yrs.)	0.95 (0.63-1.42)	0.95 (0.62-1.45)	**2.03 (1.35-3.05)**	**1.69 (1.10-2.62)**	1
Low educational level of parents	**1.99 (1.19-3.33)**	**2.14 (1.26-3.62)**	**2.71 (1.55-4.73)**	**2.56 (1.45-4.52)**	1
Structural family characteristics	0.83 (0.49-1.41)	-	**1.66 (1.04-2.66)**	-	1
Mother under age 21 at birth child	2.22 (0.85-5.85)	-	**3.12 (1.24-7.85)**	-	1

*adj = adjusted for all other variables which are included in the multivariate model

children with a disputed social status were more hyperactive from kindergarten through age 12.

Furthermore, PCH-identified early internalizing problems were not predictive of either social status, not even in our univariate analyses. This is surprising given that many studies have shown that socially withdrawn children are often rejected by their peers.[28] Either poor early identification of internalizing problems[29] or discontinuity in this type of problem might explain this; further research on this is needed.

Strengths and limitations

The strengths of this study lie in its large sample and its embedding in routine PCH, a program that reaches over 90% of the total Dutch population. Moreover, we made use of data registered during the routine health and developmental monitoring that is offered to all Dutch children, and which is collected and registered according to a highly standardized format.

Some limitations should be taken into account when interpreting the findings. First, peer information was only available for a subset of the TRAILS population; adolescents in special education were not included in the subset, and in our subsample behavioral problems occurred less frequently than in the remaining group. However, it may be inferred that the predictive power of early PCH findings for this group is even better. Second, children may have received effective treatment for their developmental and behavioral problems between the ages of 4 and 11, leading to an underestimation of the predictive power of PCH findings. A related issue is that some highly predictive risk factors may not have been included in our models because, due to their low prevalence, they did not show multivariate or other effects. This may, for instance, be the case for birth defects. Finally, there might be some information bias, for example, regarding alcohol use. PCH risk factors were assessed in the early 1990s and the validity of these risk factors is high. However, regarding alcohol use during pregnancy, at the time clear guidelines did not yet exist about drinking alcohol during pregnancy.[30]

Implications

We are the first to study multiple early childhood predictors – from PCH files – of neglected and rejected young adolescents who were assessed with peer nominations, in a longitudinal design. PCH professionals could closely monitor children and adolescents identified in such a way, and provide early counseling or treatment if needed. There are several effective interventions for acquiring better social skills, and building friendships and self-esteem.[31-33] As our study is the first of its kind, our results are in need of replication by other studies, with larger sample sizes and including the possibility of examining gender differences.

Findings from PCH professionals on early childhood development and social behavior are predictive for a neglected and rejected status in preadolescence from the general population. PCH is a good setting to monitor the social status of children and adolescents.

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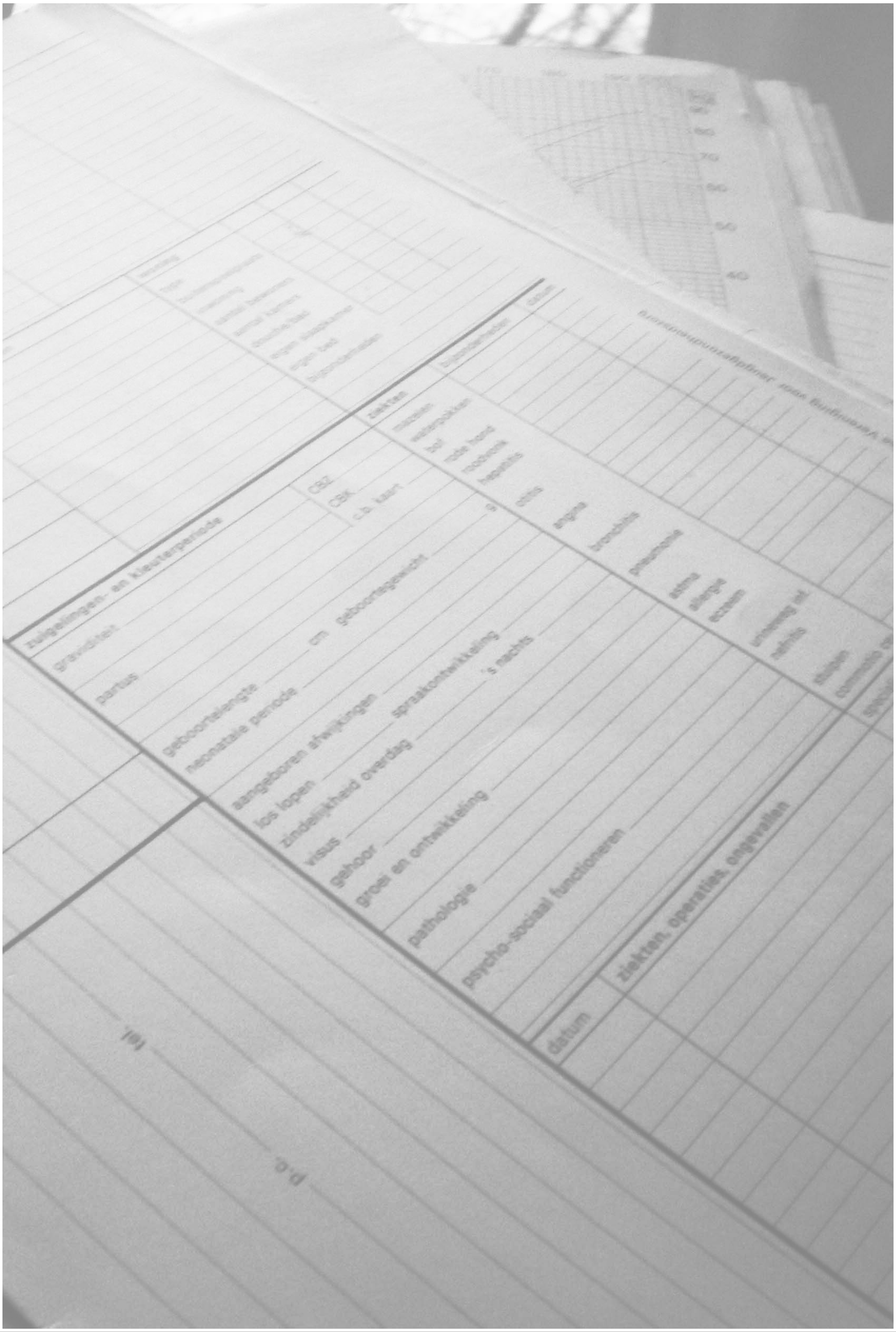
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Validity of parental recall on pregnancy, birth and early childhood behavior

M. Jaspers
G. de Meer
F. Verhulst
J. Ormel
S. A. Reijneveld

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Abstract

Objective

Evidence on the validity of parental recall of early childhood behavior is lacking. Our aim was to examine the validity of parental recall at child age 10-12 for maternal lifestyle during pregnancy, birth characteristics and early childhood behavior.

Study Design and Setting

The study population comprised 2230 children and their parents. Children were recruited from elementary schools at 10-12 years of age (response: 76.0%). Parents were asked to recall lifestyle during pregnancy, birth characteristics, and childhood behavior at age 4-6. Recalled data were compared with information registered by Preventive Child Healthcare (PCH) from birth onwards.

Results

For birth weight and gestational age, we found no systematic difference between recalled and PCH-registered data; 95% limits of agreement were ± 1.2 pounds (600 grams) and ± 2.4 weeks respectively. For maternal alcohol use during pregnancy and early childhood behavior problems, Cohen's kappas were low (0.03-0.11). Compared to PCH registration, parents tended to overreport at age 10-12. In contrast, kappa was high for maternal smoking during pregnancy (kappa: 0.77).

Conclusion

Retrospectively collected information on lifestyle during pregnancy, birth and early childhood behavior is biased, which limits its value in estimating the contribution of early life adversity to health in later life.

Introduction

The period from conception until school age is considered to be extremely important for children's socio-emotional development.[1-3] It can be a 'window of opportunity'[4] and a 'window of vulnerability', depending on the outcome, and it can offer great opportunities to improve further life by reducing adverse environmental factors and/or empowering positive factors.

Early life factors that are associated with future mental and physical health of the child concern either pregnancy, birth or early childhood.[5-14] Pregnancy factors are for example maternal smoking, alcohol use, drug abuse, medication and disease during pregnancy. These have been shown to be risk factors for the development of psychopathology,[5,7-9,11] growth retardation, respiratory problems, cardiovascular disease and other health problems.[6,13] Similarly, birth factors such as low birth weight and premature birth can lead to a number of health problems.[8,13] Early childhood factors are for example toddler sleep problems,[10,14] early eating problems[15,16] and preschool problems with social behavior,[2] which are predictors for later mental health problems.

Ideally, the effects of early life factors should be studied in follow-up studies in which information on these early life factors is collected from various sources (e.g. parents and professional assessment) in the period from conception to school age, follow-up extends to adolescent or even adult age, and attrition and loss-to-follow-up rates are low. However, most studies rely on retrospective data collection, which may introduce information bias. This may concern recall bias due to differences in validity of subject recall, marked by an over- or underreport of information. Or it may for instance be rumination bias, which occurs when people with a disease tend to think harder about their prior exposures than healthy people, causing them to systematically remember exposure differently.[17] This distorts the measurement of the association between exposure and disease. The magnitude and direction of this distortion are difficult to predict.

Many previous studies on early risk factors for adverse future mental health relied on retrospectively collected data and included a limited number of risk factors. The validity of data collected retrospectively needs to be examined before using them to estimate relationships with health or developmental outcomes. Regarding early life factors, previous studies found good recall for maternal smoking during pregnancy,[18-20] for gestational age[20-22] and for birth weight,[19,20,23-26] but not for alcohol use during pregnancy.[18,19] However, most of these studies covered a limited period of time and did not consider a combination of variables. So far, no studies are available on the validity of parental recall of early childhood behavior and neither of pre- and perinatal factors.

The aim of the current study is to examine the validity and precision of recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior in a community based sample. For this purpose we compared data on prenatal and early life characteristics

collected at child age 10-12 with data registered by Preventive Child Healthcare (PCH) from birth onwards.

Methods

Study population and procedure

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch 10-12 year old children aiming at adolescent psychosocial development and mental health. The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities in the northern part of the Netherlands.[27,28] Of all children approached for enrolment in the study (n=3145) 6.7% were excluded because of mental or physical incapabilities or language problems. Of the remaining 2935 children, 76.0% (n=2230, mean age=11.09, SD=0.56, 50.8% girls) both child and parent agreed to participate. Responders and non-responders did not differ with respect to the prevalence of teacher-rated problem behavior nor regarding associations between socio-demographic variables and mental health outcomes.[27] Data collection occurred by parent completed questionnaire and a home-visit by trained interviewers. Furthermore, participants were asked for permission to retrieve the child's file from Preventive Child Healthcare (PCH). The PCH provides health and developmental monitoring to all Dutch children from birth until age 19, and participation rate is over 90%.[29,30]

For the current analyses, we used data from the PCH files on maternal lifestyle during pregnancy, birth characteristics and early childhood behavior, and data from the first wave of TRAILS when the child was 10-12 years of age. Data of TRAILS wave 1 were collected by well-trained interviewers during a home-visit, including parent completed questionnaires that comprised the Child Behavior Checklist (CBCL) and sociodemographic variables. Since surveillance protocols differed between the three participating PCH services, numbers for included variables differ considerably.

Maternal lifestyle during pregnancy

Maternal lifestyle during pregnancy concerned smoking and alcohol use. In TRAILS, these were asked for by the following questions: "How much did the mother smoke during pregnancy?" and "How much alcohol did the mother drink during pregnancy?" The answer categories comprised five categories varying from "never" to "more than two packs of cigarettes a day" for smoking, and from "never" to "more than 20 glasses per week" for alcohol use. For the current analyses we compared "never" to the other categories combined (i.e. "ever") for smoking or alcohol use. In the PCH files smoking and alcohol use were assessed as: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?", respectively, similarly dichotomized as ever/never.

Birth characteristics

Birth characteristics concerned gestational age and birth weight. In TRAILS these were asked by the following questions: "How much did the child weigh at birth?", and "How many weeks did the pregnancy last?", in pounds (500 grams) and weeks, respectively, which present common measures of birth weight and gestational age in the Netherlands. In the PCH files, these data were registered in grams and days, respectively, as provided by the obstetrician or midwife. Aiming at a similar precision of TRAILS and PCH data, PCH data on birth weight were transformed to pounds (500 grams), and those on gestational age were converted to completed weeks.

Early childhood behavior

Early childhood behavior concerned 'sleeping problems', 'eating problems', and 'social behavior problems' at age 4-6. In the TRAILS data collection, parents filled out a questionnaire on the child's behavior when it was in kindergarten (age 4-6). Sleeping and eating problems were considered to have occurred if parents gave a confirmative answer on the following questions: "Didn't … (name child) want to eat?"; "Did … (name child) have problems falling asleep?"; "Did … (name child) have problems sleeping through the night?" Social behavior problems were assessed by the following questions: "In comparison with other children:" "was your child quickly anxious?"; "was your child shy?"; "was your child quick tempered?". Answering categories concerned a 5-point Likert scale (from "much more" to "much less"), and problems were considered to have occurred if parents reported "more" or "much more".

In the PCH files, 'sleeping or eating problems' were assessed by the following predefined questions: "Does the child have any problems eating?", and "Does the child have any sleeping problems?". 'Social behavior problems' was measured based on the information that the PCH professional registered at the following predefined items in the records 'how is the child's behavior?', 'social behavior?', and 'psychosocial functioning?'. For each, the following descriptions could be used: 'quick tempered', 'shy', 'anxious' or 'no problem', the latter being contrasted to the other categories. A social behavior problem was considered to be present only if any of these three items was filled out affirmatively.

Child Behavior Checklist

Behavioral and emotional problems at age 10-12 were assessed by the parent completed Child Behavior Checklist (CBCL) for ages 4-18, an internationally validated questionnaire for child emotional and behavioral problems.[31,32] In the current study we used the Total Problems Score and two broadband scales, Externalizing and Internalizing Problems. The Total Problems score is the sum of all individual item scores (118 items). Internalizing Problems consists of the Anxious/Depressed, the Somatic Complaints and the Withdrawn/Depressed syndrome scales. Externalizing Problems consists of the Aggressive Behavior and Delinquent

Behavior syndrome scales. Cases were allocated to a normal range or a clinical (elevated) range, using the age and gender-specific 90th percentiles of the Dutch normative sample for the scales concerned as cut-off.[32]

Statistical analysis

Statistical analyses were performed using SPSS version 12. For continuous variables, i.e. gestational age and birth weight, the agreement of values from the two sources (PCH registration and TRAILS parental recall) was estimated using the stepwise method described by Bland and Altman.[33,34] First, we evaluated the data for systematic differences between PCH-registered and recalled values. Using a paired t-test, we tested if the mean differences between the two birth weights (PCH-registered versus TRAILS recalled) deviated from 0, to test for systematic deviation. Subsequently, the difference between PCH-registered and recalled values were plotted against their mean value to evaluate a potential relationship of deviation with mean scores. After exclusion of systematic differences, 95% limits of agreement were calculated as the mean differences ± 2 SD, which mark the precision of the association between the two measures, i.e. random deviation.

Cohen´s kappa (agreement adjusted for chance agreement) values were calculated as a measure of concordance between registered (PCH) and recalled (TRAILS) dichotomous variables, i.e. maternal lifestyle during pregnancy and early childhood behavior. Cohen's kappas between 0.40 and 0.75 were considered as moderate to good agreement, above 0.75 as excellent. If kappa was below 0.40 then we also calculated the percentage over- and underreports (where differences were assessed, using McNemar tests where $p<0.05$ was considered a significant difference).

Parental recall can be influenced by the occurrence of child behavioral and emotional problems at the moment of recall, so we examined the agreement between PCH registration and TRAILS parental recall for children with and without an elevated CBCL score at the moment of recall. We did this using logistic regression for the outcomes most likely to be affected: maternal lifestyle during pregnancy, birth characteristics and early childhood behavior.

Results

Description of sample

Of the 2230 TRAILS participants, 2139 (96%) parents gave permission to retrieve the child's file from the PCH. Out of these, 88% could be traced (n=1879 files, mean age=11.06, SD=0.54, 50.9% girls). Parent-recalled TRAILS data at age 10-12 differed with statistical significance between children with retrieved PCH data and with non- retrieved data for two out of the nine outcomes assessed. These were parent-reported maternal alcohol use during pregnancy (19% for the retrieved vs. 15% for the others, $p<0.05$), and problems with eating at child age 4-6 (18% vs. 13%, respectively, $p<0.05$). A considerable proportion of data missed on some

variables in the retrieved PCH files, further called PCH item non-response, ranging from 64.2% regarding maternal behaviors to 30.4% regarding early child behaviors (Table 2). PCH item non-response rates varied in particular between the five sites of data-collection, each site representing a different PCH service. Regarding maternal smoking and alcohol use, PCH item non-response was 96.9% in one site, compared to 38.8% for the other four sites, ($p<0.001$). After adjustment for site, PCH item non-response for these maternal behaviors did not vary by sociodemographic factors (all $p>0.05$). Regarding early child behaviors, PCH item non-response did also not vary by any of these background characteristics.

In the retrieved PCH files 37.3% of the mothers had a low educational level, 35.5% intermediate, and 27.1% had a high educational level. Fathers had a higher educational level on average, i.e. 32.4% low, 32.2 intermediate, and 35.4% high respectively. Of all families, 21.0% (n=454) was divorced (at child age 11). 8.7% of the children had no siblings, 48.9% one, 29.5% two, and 12.9% three or more.

Birth characteristics

Table 1 shows mean values for birth weight in pounds and gestational age in weeks for parent-recalled TRAILS values and PCH-registered values shortly after birth. For both outcomes the mean values differed with statistical significance but the actual differences were close to zero and not clinically relevant, i.e. 0.05 pounds (25 g) for birth weight and 0.08 weeks (0.6 days) for gestational age. The statistical significance is likely due to overpowering of the sample size with respect to the estimation of a clinically relevant difference in birth weight and for gestational age.

Table 1. Difference between recalled en registered values for birth weight and gestational age

	Birth weight, units of 500 gram (SD) n = 1691	Gestational age, weeks (SD) n = 1696
Recalled[a]	6.8 (1.2)	39.7 (1.8)
Registered[b]	6.9 (1.1)	39.7 (1.9)
Mean difference (95% C.I.)	+0.05 (0.02; 0.16)	-0.08 (-0.13; -0.04)

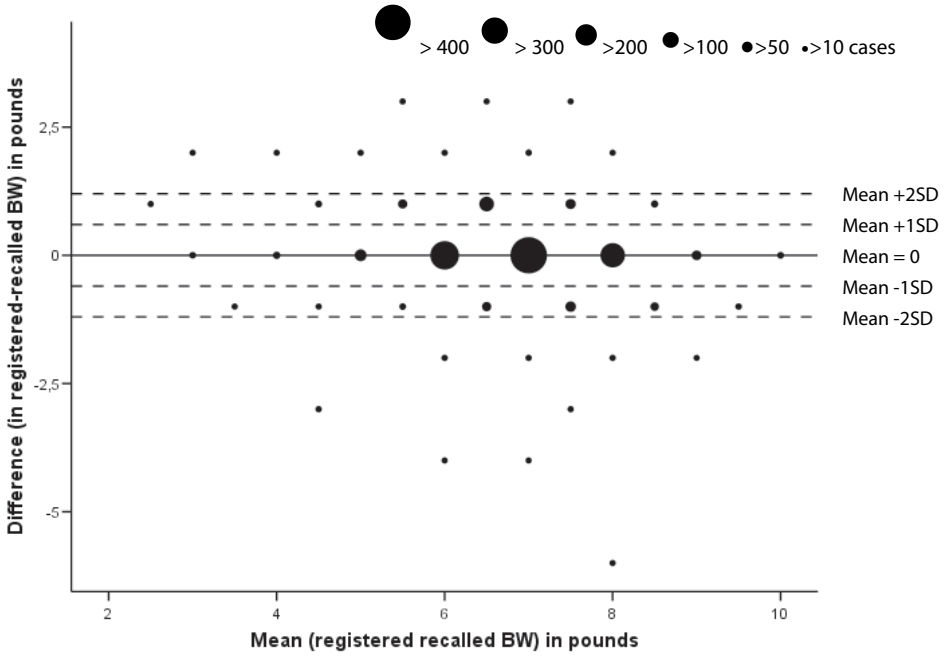
[a] retrieved from TRAILS data collected at child age 10-12

[b] retrieved from the PCH files, recorded at birth

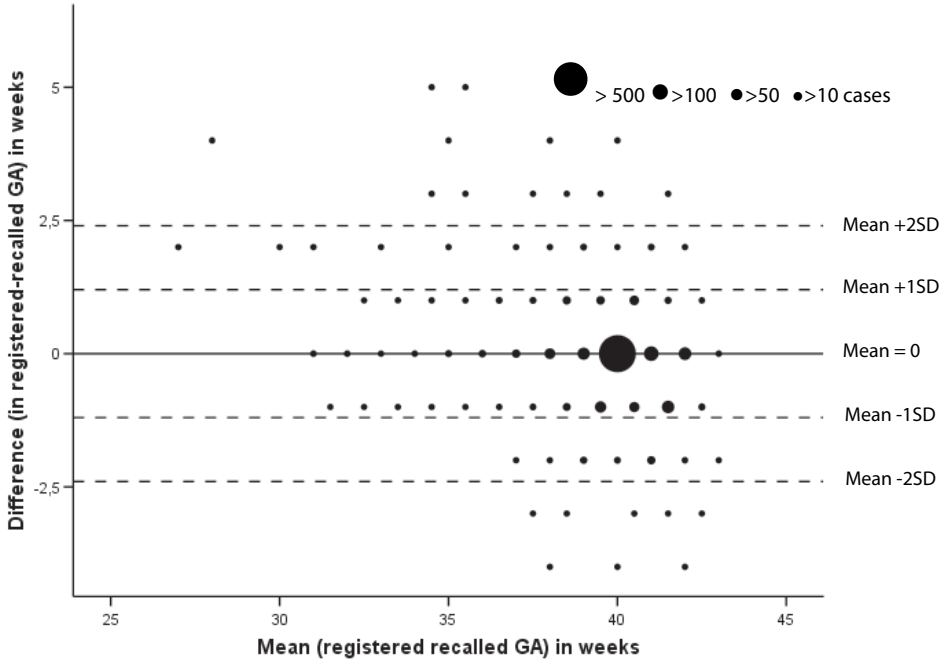
Plots of the differences between recalled and reported values against their mean value (Figures 1A and 1B) showed no relation between the difference and mean values. The 95% limits of agreement of recalled compared to registered values were 0.0 ± 1.2 pounds (600 grams) for birth weight and 0.0 ± 2.4 weeks (17 days) for gestational age, i.e. ± 17.4% and ± 6.0% of the mean values for respectively birth weight and gestational age.

Figure 1. Plot of difference between recalled and registered values, against the mean values

A. Birth weight (n=1691), maximum per dot = 446 cases



B. Gestational age (n=1696), maximum per dot = 525 cases



Maternal lifestyle during pregnancy

Concordance between recalled (TRAILS) and PCH-registered maternal lifestyle during pregnancy was high for maternal smoking (kappa: 0.77 (95%C.I. 0.71; 0.82)) and low for maternal alcohol use during pregnancy (kappa 0.09 (95%C.I. 0.00; 0.19)) (Table 2). For smoking, rates of underreporting and overreporting were equal (4.7% and 5.6%, McNemar $p>0.10$), but parents tended to overreport retrospectively at age 10-12 maternal alcohol use during pregnancy: 19.7% overreport compared to 3.7% underreport (McNemar test $p<0.001$).

Early childhood behavior

Table 2 also shows concordance for eating, sleeping and social behavior (all at child age 4-6). For all studied markers of early childhood behavior, concordance was low, kappa values ranging from 0.03-0.10. Overreport occurred more frequently than underreport for most outcomes (McNemar tests: $p<0.001$), except for eating problems (McNemar test: $p>0.10$). We repeated these analyses for severe child behavior problems, if parents reported that their child had "much more problems compared to other children". The proportion of overreport reduced to 2.4%, 2.4% and 2.8% for quick temperedness, anxiety and shyness, respectively. However, kappa values remained low (0.02-0.11).

Parental recall may be related to child emotional or behavioral problems. Therefore, logistic regression analyses were performed on the relationship of (dis)agreement between registered and recalled information and the parent completed Child Behavior Checklist (CBCL). None of the associations between (dis)agreement and dichotomized CBCL scores (clinical vs. normal) was significant, neither for the CBCL Total Problems score, nor for Internalizing or Externalizing Problems (results not shown).

Discussion

In this large community-based sample we studied the validity of parental recall over a 10-12 year period for maternal lifestyle during pregnancy, birth characteristics and early childhood behavior. Results show that parental recall of birth weight and gestational age is valid (no systematic error) but not very precise. For maternal alcohol use during pregnancy, and early child behavior, recall was poor. A good recall was observed only for maternal smoking during pregnancy.

To our knowledge this study is the first to examine validity of parental reports of a number of prenatal and early life factors over a 10-12 year period, using data collected in a community-based setting at both time points. Moreover, this study is the first that studies parental recall of early child behavior characteristics which is considered highly relevant for the development of psychopathology later in life.

For birth weight and gestational age, no systematic difference was observed for recalled and PCH-registered data which confirms previous studies.[19-26] However, when taking into

Table 2. Prevalence rates (dis)agreement and kappas for maternal lifestyle during pregnancy and early childhood behavior according recorded and recalled data

	%prevalence		%agreement		%disagreement		Kappa (95% C.I.)
	PCH	TRAILS	Denial	Confirmation	Overreport	Underreport	
Maternal lifestyle during pregnancy							
Smoking, n = 708	33.3	32.2	62.0	27.7	4.7	5.6	0.77 (0.71; 0.82)
Alcohol use, n = 679	6.0	22.1	74.2	2.4	19.7*	3.7*	0.08 (0.00; 0.19)
Early child behavior							
Sleeping problems, n = 666	3.0	18.1	80.4	1.5	16.6*	1.5*	0.10 (0.00; 0.22)
Eating problems, n = 673	13.4	13.1	77.1	3.6	9.5	9.8	0.15 (0.00; 0.19)
Shyness, n = 1307	3.4	23.7	74.8	1.9	21.8*	1.5*	0.09 (0.01; 0.16)
Anxiety, n = 1308	0.6	15.8	83.9	0.3	15.5*	0.3*	0.03 (0.00; 0.11)
Quick tempered, n = 1309	3.0	15.7	82.1	0.8	14.9*	2.2*	0.03 (0.00; 0.09)

* Significant difference between over- and underreport, $p < 0.05$ (McNemar tests)

consideration the precision of recall, the use of recalled data adds considerable random error to all findings. For birth weight, the 95% range of recalled values deviated 17.4% from the mean value, and for gestational age 6.0%. Methodologically, these findings also clearly show the merits of the rigorous assessment procedure of agreement as proposed by Bland & Altman.[33,34]

For maternal lifestyle during pregnancy our results are in agreement with previous studies that also observed an acceptable agreement for smoking and a poor one for alcohol use.[18,19] The recall of early child behavior was poor as well. However, the total rate of agreement (confirmation and denial put together, Table 2) for maternal lifestyle during pregnancy and of the child at age 4-6 was high. This counterintuitive finding can largely be explained by the low proportions of confirmations on both occasions (TRAILS and PCH). The kappa statistic has been shown to be sensitive to extremes in prevalence and unbalanced margin totals leading to lower kappa values,[35] but that explains the low kappa value in our study to a very limited degree. The discordance for the child behavior problems can also be caused by the fact that the PCH files did not mention the length of time these problems lasted, while the question at age 11 was focused on the whole kindergarten period. Finally, child behavior problems in this study mostly comprised internalizing behavior, i.e. anxiousness, shyness, and sleep problems. Faraone et al.[36] showed that parental recall of psychopathology of their child after one year was much better for externalizing than for internalizing problems. Our findings show that this holds to an even higher degree if the period of recall is longer.

Alcohol use during pregnancy and early child behavior were reported more frequently in the TRAILS data compared to PCH-registered data. This may be due to either an overreport at age 10-12 or an underreport in the PCH files. A likely source of overreport might be child behavioral and emotional problems at 10-12 years of age. In this population, however, parental recall was unrelated to child emotional or behavioral problems. An underreport in the PCH registration may have occurred for alcohol use during pregnancy. At the time of PCH registration in our study population, the early 1990´s, there was no consensus on the effect of non-habitual alcohol use on fetal development. However, kappa values did not change when we focused on more frequent use. In addition, parents may have underreported alcohol use because of the setting and timing of PCH registration. Lifestyle during pregnancy was asked for during the first PCH visit only, which is shortly after birth. The setting and timing may evoke emotions that lead to recall.[37]

Strengths of this study are its large, community-based sample and the preventive health care setting. Moreover, we made use of data registered during routine health and developmental monitoring offered to all Dutch children and collected and registered according to a highly standardized format. We retrieved 88% of the PCH files as expected based upon the 90% participation reported from national data.[30] So there is no or limited bias from parents report. However, information on reasons of non-retrieval was not available.

Our study has some limitations. First, though we consider the PCH data to be most valid, we cannot exclude that these are subject to some bias too. In particular, parent-reported information may have been influenced by the report being to a PCH professional and being registered by that professional. Regarding this, only birth weight and gestational age registered in the PCH files can be considered as true reference values. Second, the low prevalence of some behavior may have resulted in somewhat too low kappa estimates, but the impact of this is rather small. Thirdly, some of the outcomes as studied were only registered in a part of the PCH encounters, which could have introduced bias if occurring in association with child characteristics. However, site appeared to be the only predictor of this non-response and only regarding maternal behaviors. This indicates that the missingness of some items is in particular due to differences between services in their registration policies as at that period each site was served by a different PCH service. Apparently, in that period, services differed in their policies on how to spend the very limited time per encounter (approximately 10-15 minutes), with in most services the registration of past maternal behavior having a much lower priority than current child behavior. Finally, the non-response of 24% in the TRAILS study could have led to selection bias in our findings. However, we found no differences between responders and non-responders in the prevalence of teacher-rated problem behavior nor regarding associations of socio-demographic variables and mental health outcomes, which makes the occurrence of selection bias rather unlikely.

Summarized, we observed a poor parental recall after a 10-12 year period for maternal lifestyle during pregnancy, birth characteristics, and early childhood behavior, which was mostly due to over-reporting at age 10-12. This should be taken into account when asking retrospectively about these events, either by researchers or by clinicians. We conclude that retrospectively collected information of early life adversities is of limited value for estimating the contribution to child (public) health.

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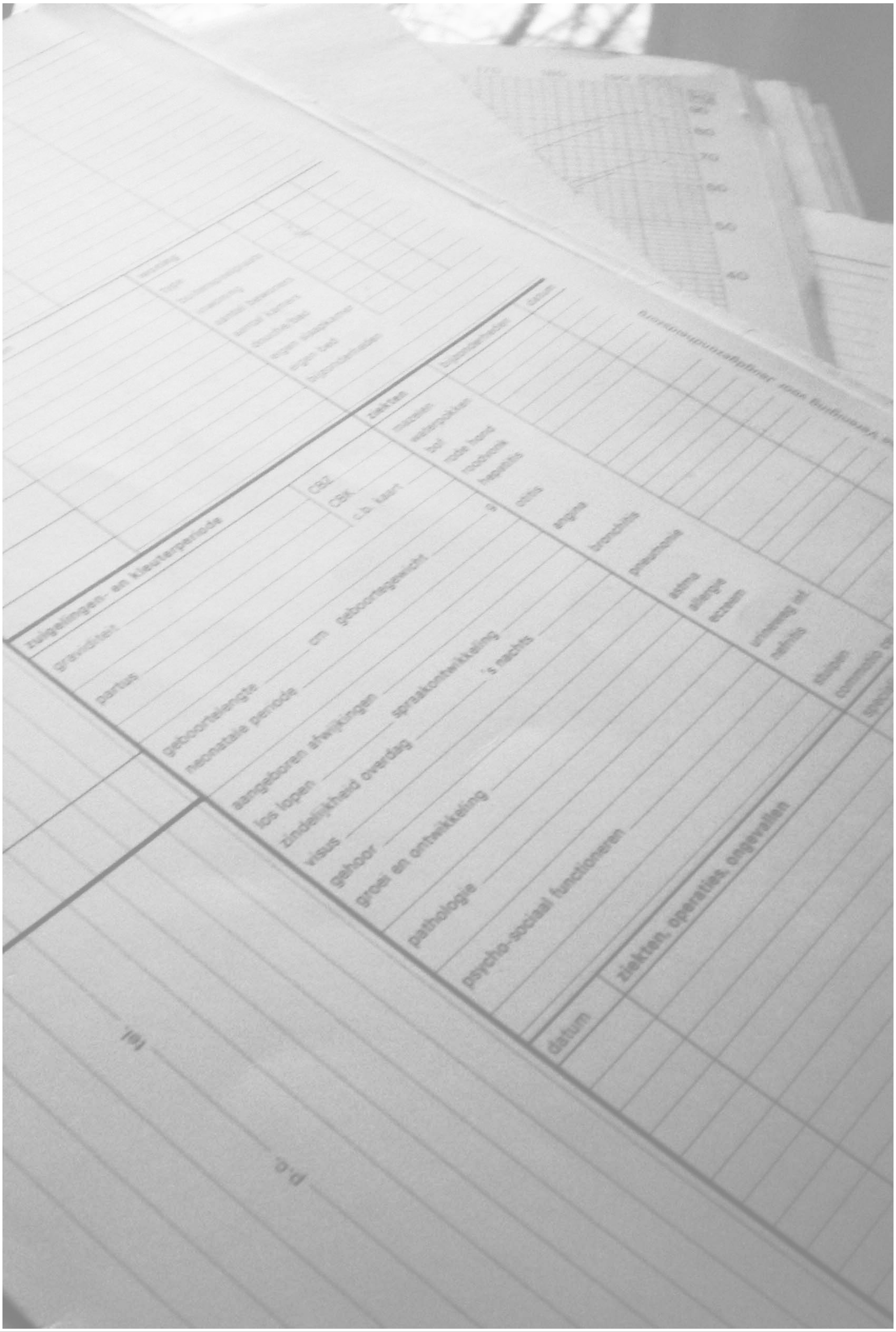

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General Discussion

Introduction

The main aim of this thesis was to investigate whether early findings of PCH professionals predict psychosocial problems in adolescents from the general population. Other aims were to investigate early childhood indicators for social status in preadolescence and to examine the validity and precision of recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior.

Our aims have been translated into the following research questions:

1. Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH?
2. Which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting?
3. Can we identify early indicators of autism spectrum disorder and attention deficit hyperactivity disorder problems with early childhood findings as registered by PCH?
4. Can we predict which children have a heightened chance of being disliked or ignored by their preadolescent peers with data from the routine PCH?
5. How is the validity of parental recall on pregnancy, birth and early childhood behavior in preadolescence?

In this general discussion a summary of the findings is presented, followed by a discussion of these findings and the methodological considerations, and finally, implications for practice and suggestions for future research are given.

Main findings

The research question in Chapter 2 was: Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH? For that we developed and validated -in two data sets- a prediction model for psychosocial problems in preadolescence based on data from routine preventive child healthcare on childhood factors in early life. Early childhood findings were measured during pregnancy and at age 4, while psychosocial problems were measured at age 11. PCH-registered behavioral problems, attention hyperactivity problems, enuresis, level of education of the father, and being male all predicted externalizing problems. Internalizing problems were predicted by maternal smoking during pregnancy, sleep problems and being male. Surprisingly, the absence of certain data was predictive for psychosocial problems. The predictive power of PCH-registered early childhood data was rather modest for behavioral problems, with areas under the curve indices being 0.66 (95% CI 0.59-0.72). This means that PCH-registered early childhood data correctly predicts externalizing problems in children at age 11 in 66% of

cases. However, for internalizing problems, PCH data did not predict emotional problems in preadolescence.

In Chapter 3 we examined which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting. In contrast with Chapter 2, early childhood indicators (where applicable) and outcome measures were measured at different moments in time from pregnancy up to age 4 and between the ages of 11 and 17, respectively. Four types of trajectories were identified for both genders and for both types of problems. Per type of trajectory, a high trajectory of adolescents with clinical problems was identified, as well as a middle high, middle low, and low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from PCH assessments predicted each of these trajectories. All sets comprised for both genders low and middle parental educational levels, and having divorced or otherwise single parents. For trajectories of internalizing problems, sleep problems were an additional predictor for boys, while language problems were for girls. Trajectories of externalizing problems were additionally predicted by maternal smoking during pregnancy for both genders. Moreover, for boys early behavioral problems and attention hyperactivity problems were predictive.

In Chapter 4 we assessed whether early indicators of ASD and ADHD problems can be identified with early childhood findings as registered by PCH. In this chapter early indicators and ASD and ADHD problems were measured at different moments in time from pregnancy up to age 4 and between the ages of 11 and 17 years, respectively. Several early childhood indicators were identified that predicted ASD and ADHD problems. Male gender and the absence of parent-reported positive behavior at toddler age were generic indicators, while a low birth weight, social behavioral problems, language, and psychomotor and eating problems at toddler age were specific indicators for ASD problems. Low level of education of the mother, maternal smoking during pregnancy, gross motor skills during infancy, and attention hyperactivity problems at toddler age were specific indicators for ADHD problems.

In Chapter 5 we described the prediction of which children (in preadolescence) have a heightened chance of being disliked or ignored by their peers based on routine data from the PCH. Early childhood indicators were measured at different moments, from pregnancy up to age 4. Findings show that several early childhood indicators were predictive for neglect and rejection by peers. Children with a low birth weight, early motor problems, early sleep problems, and children with parents with a low educational level were more likely to have a neglected status; children with early attention hyperactivity problems were less likely to be so. Boys, children with parents with a low educational level, and children with externalizing problems in toddlerhood were more likely to have a rejected status in preadolescence.

Our final research question in Chapter 6 was: How is the validity of parental recall on pregnancy, birth and early childhood behavior in preadolescence? Retrospectively collected information on lifestyle during pregnancy, birth and early childhood behavior (in kindergarten) is sometimes biased, which limits its value in estimating the contribution of

early life adversity to health in later life. Findings show a poor parental recall after a 10-12 year period for maternal alcohol use during pregnancy and early childhood behavior, which was mostly due to over-reporting at age 10-12. In contrast, the recall of maternal smoking during pregnancy was good. For birth weight and gestational age, no systematic difference between recalled and PCH-registered data were found.

Discussion of the main findings

Much of the effort documented in this thesis was aimed to improve the quality of preventive child healthcare by expanding our knowledge of the predictability of early PCH findings. Regarding this, it indeed has yielded interesting new findings.

Identification of predictors of future psychosocial problems might aid PCH professionals to improve their monitoring of the development of children and might facilitate early treatment or referral of potential vulnerable children. Our findings are also important for the long-term perspective of these children and their chances of developing psychosocial problems. The long-term economic costs of childhood and adolescent psychosocial problems are high; a lifetime cost in lost family income is approximately $300.000. Large negative effects are found on educational accomplishments and the ability to work and earn as adults.[1]

A parsimonious set of data from early PCH assessments predicts psychosocial problems in (pre)adolescence, but only to a moderate degree. The effect sizes of the predictors are modest. Externalizing, ASD and ADHD problems can be better predicted with early PCH data than internalizing problems. Although several predictors were identified which may facilitate the PCH professionals in their work, our results show the difficulty of accurate prediction of psychosocial problems from early PCH findings. This was shown in different chapters with different approaches. The only modest predictive power of early PCH findings may disappoint. Several considerations should be accounted for to reach a balanced appraisal of them. Below we first take into account the previous studies on the validity of PCH findings, then look at some methodological considerations and finally discuss predictors and effects of missing data in our study.

So far, there have been mainly studies on the short-term prediction of psychosocial problems in a PCH setting, e.g. the studies by Harland et al.[2], Brugman et al.[3] and Reijneveld et al.[4,5] Harland et al.[2] showed that psychosocial problems as measured by the CBCL are more prevalent among some risk groups such as children whose parents are unemployed or divorced. Reijneveld et al.[6] showed that ethnic minority groups also have a higher chance of developing psychosocial problems. However, we are the first to study long-term prediction of psychosocial problems based on PCH findings. Compared to these previous studies our effect sizes are smaller, i.e. the predictive power of these predictors seems to decrease in time.

How to explain the fact that our effect sizes are smaller? An explanation for this finding is the large variation in the course of the psychosocial problems in children and adolescents[7-11] which makes long-term prediction difficult. During the long period (6-7 years) between our predictors and our (first) outcome measures, life events, at home and at school, and provision of mental health care can effect the occurrence of psychosocial problems, thus diluting the association between predictors and outcomes. If we had measured other determinants of mental health between age 4 and 11, we probably would have measured more precisely and more validly. If we had been able to adjust for these factors, we might have found a stronger prediction (bigger effect sizes) and possibly even more and/or other predictors in our studies. With respect to mental health care previous research does show that PCH professionals take action in 85% of the cases for which they identify psychosocial problems and in 20% they refer for further diagnostics and treatment.[3,5] However, it is important to realize that PCH professionals relatively often identify psychosocial problems in children who do not have a heightened score on the CBCL[3,5] and we do not know if the referral by the PCH actually took place. So previous research does not give us a clear picture of how many children seen by the PCH professionals receive an intervention if psychosocial problems are present.

A second explanation, for the fact that our effect sizes are relatively small, is that the data of the PCH used in this thesis are approximately 20 years old, so we are looking at the performance of the PCH 20 years ago. Would more recent PCH data give a different picture of the performance of the PCH on awareness of early risk factors for psychosocial problems? This seems likely given the number of additional tools,[4,12-14] trainings[15] and guidelines[16-18] provided since then. We do not have a comparison for our data on the entire 20 years period. However, a recent study, on a part of that period (between 1997 and 2003), by Theunissen et al.[19] shows that the quality of problem identification in children by the PCH has not improved in the last years after a series of nation-wide interventions.

Another interesting finding of our studies is the predictive power of some indicators for several outcome measures. It is striking that we identified several predictors which are rather similar for various psychosocial problems and for a disputed social status, e.g. maternal smoking during pregnancy, early behavior problems, early attention hyperactivity problems, a low level of education of parents and divorce of parents. The set of predictors consists of both family factors and child factors, which are important in the prediction. Regarding family factors, the level of education of the parents is predictive for all psychosocial problems. Other family factors are also predictive such as divorce of parents. For the child factors, early behavior of the child is important to predict many psychosocial problems (but not internalizing problems) and a disputed social status.

Data on early development as registered by PCH are mostly not predictive for internalizing problems in (pre)adolescents. An explanation for this might be that few early childhood features are predictive for later internalizing problems. Perhaps having a genetic vulnerability is much more important for developing internalizing problems than these early risk factors. In the methodological consideration some other aspects will be discussed as well.

A second possibility is that PCH professionals might not be adequately identifying or registering those factors that are predictive.

Psychosocial problems were more likely when PCH had not registered findings on some aspects of early development, that is, when these data were missing. Several explanations were given in Chapter 2 as to why PCH professionals did not always register every item. First, the PCH professional might not have had enough time for the assessments and registration especially in multiple-problem cases (the visits are short, with many competing concerns). Second, certain parents of children with problems may have given unclear answers or refused to answer some questions at all. Parental knowledge and attitudes about (mental health) problems and interactions among family members and friends influence decisions to seek help or disclose problems to PCH professionals. Subsequently, the attitudes, knowledge and skills of PCH professionals who are first points of contact when families seek help, determine whether concerns are recognized and receive an appropriate response. Missing data might indicate difficulties met by the PCH professional during the assessment.

Methodological considerations

In addition to the long period between our predictors and our (first) outcome measures and the non-random missing of data, some other methodological factors may have affected our findings.

First, despite a reasonable power, some early risk indicators were low prevalent and thus might not have been identified as indicators due to their low prevalence. This may, for instance, concern birth defects.

Another methodological consideration is the use of data from routine care. PCH professionals registered data for care purposes and not for research. Consequently, there were many missing data in the PCH files. As we showed in Chapter 2 the missingness of certain data was actually predictive for psychosocial problems. Several explanations were given in Chapter 2 as to why PCH professionals did not always register every item. Because of the missingness of PCH data, we expected this would lead to even smaller effect sizes and to a loss of power. To assess if this was the case, we decided to use a different type of predictor variable(s) in the studies in Chapters 3 to 5, where we used measurements, noted at six assessments between the ages of 18 months to four years. These were then dichotomized to "yes" if any of these were present during these six occasions, or "no". Because of this, we had almost no missing data. But even with these different constructions of the predictors (in Chapter 2 and 3) we found similar results. Our effect sizes might have been somewhat stronger though if the PCH files would have been more complete.

Third, we partly used grouped problems, for example emotional problems, as outcome measures and not specific disorders such as depression. If one examines the level of disorders possibly different predictors and/or different effect sizes might have been found, as we found in our study for ASD and ADHD problems.

A final methodological consideration concerns the TRAILS sample. The sample was largely representative for the Dutch population that is seen by PCH. However, a very small number of parents (4%) participating in TRAILS did not consent to retrieve their child's PCH file. Also, the percentage of children from ethnic minority groups and of children who were unable to participate in TRAILS due to mental and cognitive abilities in this study is smaller than in the Dutch population as a whole. This could have consequences for the estimation of the predictive power, because there are indications that the PCH is less successful in detecting psychosocial problems of children from ethnic minority groups.[6,20] Therefore, we expect that the small share of ethnic minorities in the TRAILS sample leads to a relative overestimation of the predictive power for the Dutch population as a whole. For children with intellectual disabilities on the other hand, we would expect that their limited share in the TRAILS sample leads to an underestimation of the predictive power for the Dutch population, considering that there usually is an early identification for this group, which makes that these children are monitored more often and files are filled out more complete and rigorously.[21]

Implications for practice of the Preventive Child Healthcare

The identification of children with psychosocial problems is one of the main tasks of PCH. Now that the Dutch PCH is transitioning to an even more evidence based healthcare service where psychosocial development of children is very important, the focus is shifting more towards high risk groups and more personalized care. Our findings give an insight from PCH data which children are more vulnerable for developing psychosocial problems. PCH may move towards targeting care more at that group.

Our research shows room for improvement of PCH. First, the assessment of early psychosocial problems by PCH might be improved. Because of the modest predictive power of early psychosocial findings for later psychosocial problems, the PCH should employ additional tools when they screen for psychosocial problems. How can PCH improve their detection of psychosocial problems? As previously discussed by Vogels et al.[13] and Theunissen et al.[19], tools for detecting psychosocial problems, such as short questionnaires, could further improve early detection. Moreover, Vogels et al.[13] found systematic differences between individual PCH professionals, which indicates that detection of children with psychosocial problems based only on a clinical judgment does not meet the requirements of standardization. Further standardization in the methods PCH professionals use for screening is needed. Introducing new PCH guidelines would most likely contribute to this.

Furthermore, PCH professionals should register their findings better for two reasons. The first reason is that we found that the missingness of certain data was predictive for psychosocial problems. The other is that in case a child is seen by another PCH professional, this professional misses possible important information in the file and therefore lacks a more complete picture of the development of the child. We already discussed in the

methodological considerations why PCH professionals did not always register every item. More time for the assessments of children during routine health care assessment may improve the completeness and quality of PCH files. Theunissen et al.[19] suggest the use of a short questionnaire to improve the quality of identification of psychosocial problems by PCH professionals as well as extra training, ongoing coaching by a child mental health specialist and more time for the assessment. They also mention a different type of solution, to replace the current PCH professionals, i.e. doctors and nurses, by other types of professionals, such as psychologists. However, it should be realized that replacing doctors and nurses by psychologists will likely be at the expense of other required skills.

The possible negative effects of identifying a child as having a chance of developing psychosocial problems are not yet clear. Although it seems important to identify, monitor and, if necessary, intervene in these psychosocial problems as early as possible, the PCH (and mental health professionals alike) have to be careful that they don't prematurely treat children who don't need it. Because this can lead to stigmatization and it will have a huge effect on society if -ultimately- the majority of children in the society is defined as having mental health problems. As a society we have to be aware that we cannot detect every mental health problem.

Future perspectives

In the last years several steps forward have been and are being made to reinforce evidence based working in PCH, both by the PCH professionals and researchers. Below are some examples of current studies and initiatives with this objective. At the moment validated questionnaires are being developed for ages 0-4 year to identify psychosocial problems. A current study by Theunissen et al.[19] is evaluating which of four (existing) questionnaires is the best choice to improve evidence based working. Second, Vogels, Jacobusse and Reijneveld[13] assessed whether a short Computerized Adaptive Test (CAT) can overcome the weaknesses of short written questionnaires when identifying children with psychosocial problems. They showed that it is a very promising option for the identification of psychosocial problems in children, as it can lead to an efficient, yet high-quality identification. However, the results of their simulation study need to be replicated in a real-life administration of this CAT. Third, Hielkema et al.[22] describe in their design paper a new family-centered method to identify psychosocial problems in early childhood which is being implemented within Dutch PCH. Its main features are consideration of the child's developmental context and empowerment of parents to enhance the developmental context.

Fourth, The Collaborative Centre on Care for Children and Youth with behavioral and emotional problems (C4Youth) has been set up to strengthen ties between groups involved in research and education and institutions that provide care to children and adolescents with behavioral and emotional problems.[23] More specifically, C4Youth has three objectives: 1) To exchange knowledge between professionals working in organizations and institutions for care, education, training, research and policymaking for children and adolescents (0-23 years)

with behavioral and emotional problems, and their parents/guardians (i.e. clients). 2) To develop a data collection system that allows valid and reliable assessment of (a) which care these clients use for these problems and (b) what their short-term and long-term outcomes are. 3) To obtain evidence on relevant themes to improve this care, specifically regarding (a) the entrance of these clients into care, (b) the types of care that clients actually receive and its relationship with the problems that they have, (c) the communication between clients and professionals during the process of care and its association with outcomes reached, and (d) the short-term questions of various partners of C4Youth, including questions on 'who is where in care for what' from policymakers. Fifth, the Dutch government still has youth health and care as a research priority; the Netherlands Organization for Health Research and Development (ZonMw) was recently asked to develop a new program by the Ministry of Health, Welfare and Sport, with a budget of 21 million euro.[24] Furthermore, there is a continuation of the program 'Guidelines in PCH'.

Recommendations for future research

Still further research is needed to improve the long-term prediction of psychosocial problems. Future studies could measure several moments between age 4 and age 11, to be able to correct for this period in a longitudinal study (like ours) to achieve an even clearer picture on which early risk factors are predictive of later psychosocial problems. Moreover, future research could examine whether there is a distinct set of early predictors for adolescents with comorbid problems and examine further gender differences in early indicators and predictors.

In order to unravel certain predictors research could examine these predictors more in depth. For example, in the case of single parenthood, is it the environment in which the child grows up that makes this a risk factor for psychosocial problems or is it the missing of a second role model? And if this is better unraveled how such a risk factor can be better identified and in the end be better supported by the PCH. In this way there is much less risk of stigmatization.

Because previous research indicates that children with a disputed social status and no or few friends might be more at risk for later psychosocial problems than children with (more) friends,[25] future research could use a combination of social status and friendship (nominations), this combined probably makes for an even stronger outcome measure of children at risk of a disputed social status and might generate different early predictors or stronger effect sizes.

Many previous studies on early risk factors for adverse future mental health relied on retrospectively collected data and included a limited number of risk factors. In this thesis we show that the reliability of recalled (TRAILS) data on maternal smoking during pregnancy, birth weight and gestational age was good. However, parental recall regarding maternal

alcohol use during pregnancy and early childhood behavior was poor after a 10-12 year period. Future research should take that into account.

Conclusion

This thesis shows that early findings of PCH professionals predict psychosocial problems in (pre)adolescence, but only to a moderate degree. More research is needed to further improve the long-term predictive value and robustness of early PCH findings, so that it can be better used by PCH professionals in the care they provide to children and adolescents.

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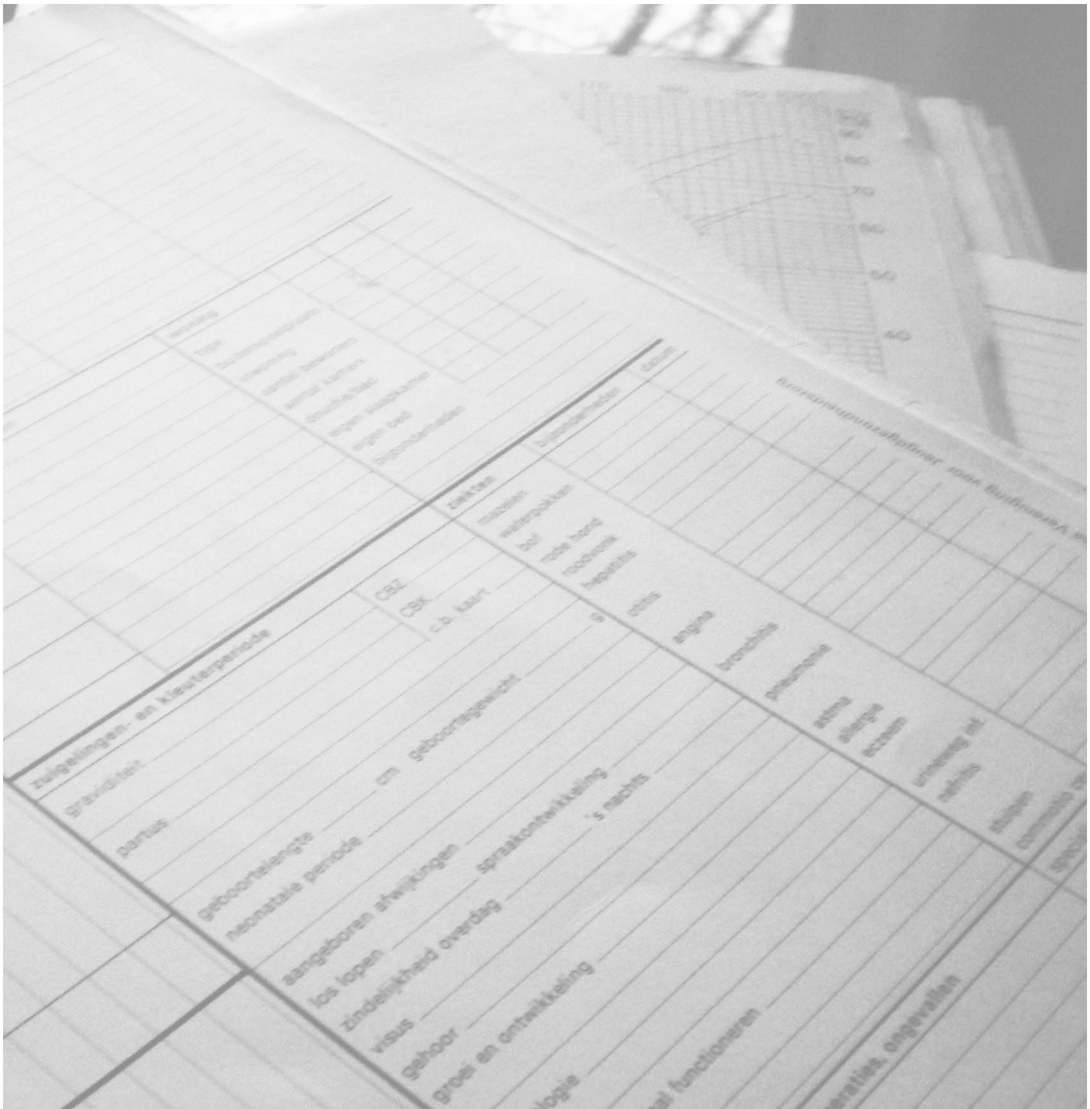
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Summary

This thesis focuses on the prediction of psychosocial problems in adolescents by early findings of Preventive Child Healthcare (PCH) professionals. In addition, it investigates early childhood indicators for social status in preadolescence and examines the validity and accuracy of parental recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior. The research described in this thesis is part of the TRacking Adolescents' Individual Lives Survey (TRAILS), a large prospective study in the general population on determinants of mental health and social development during adolescence and young adulthood. With the support of the PCH services in Drenthe, Friesland and Groningen we were able to retrieve these PCH files from their archives.

Introduction

Chapter 1 introduces what psychosocial problems are and addresses the complexity of early detection of these problems. The PCH services offer an ideal setting for the early detection of psychosocial problems. At the end of this chapter the aim and research questions are formulated and the data collection of the TRAILS study and retrieval of the PCH files is described.

The following questions were answered:

1. Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH?
2. Which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting?
3. Can we identify early indicators of autism spectrum and attention deficit hyperactivity problems with early childhood findings as registered by PCH?
4. Can we predict which children have a heightened chance of being disliked or ignored by their preadolescent peers with data from the routine PCH?
5. How is the validity of parental recall on pregnancy, birth and early childhood behavior at child age 10-12 years?

Indicators of psychosocial problems

In Chapter 2 we developed and validated -in two data sets- a prediction model for psychosocial problems in preadolescence based on data from routine PCH on childhood factors in early life. Early childhood findings were measured during pregnancy and at age 4, while psychosocial problems were measured at age 11 by parent report (with the CBCL). PCH-registered behavioral problems, attention hyperactivity problems, enuresis, level of education of the father, and being a boy all predicted externalizing problems. Internalizing problems were predicted by maternal smoking during pregnancy, sleep problems and being male. Surprisingly, the absence of certain data was predictive for psychosocial problems. The

model for externalizing problems had a modest discriminatory power (AUC 0.66, 95% confidence interval 0.59-0.72). That means that 66% of the children with externalizing problems were correctly predicted with PCH-registered early childhood data. However, for internalizing problems the AUC was 0.54 (95% confidence interval 0.47-0.60), indicating poor discriminatory power. It was concluded that findings on early development as registered by PCH are modestly predictive for externalizing problems in preadolescents, but only slightly for internalizing problems.

Trajectories of psychosocial problems

The study described in Chapter 3 examined which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting. In contrast with Chapter 2, early childhood indicators (where applicable) and outcome measures were measured at different moments in time from pregnancy up to age 4 and between the ages 11 and 17, respectively. Information on early indicators came from the records of the PCH. Trajectories of internalizing and externalizing problems were based on a combination of the parent-reported Child Behavior Checklist (CBCL) and the adolescent-reported Youth Self Report (YSR). Four types of trajectories were identified for both genders and for both types of problems. Per type of trajectory, a high trajectory of adolescents with clinical problems was identified, as well as a middle high, middle low, and low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from PCH assessments predicted each of these trajectories. All sets comprised for both genders low and medium parental educational levels, and having divorced or otherwise single parents. For trajectories of internalizing problems, sleep problems were an additional predictor for boys, while language problems were for girls. Trajectories of externalizing problems were additionally predicted by maternal smoking during pregnancy for both genders. Moreover, for boys early behavioral problems and attention hyperactivity problems were predictive. Therefore, it was concluded that trajectories of internalizing and externalizing problems during adolescence are remarkably stable and can be predicted by a parsimonious set of data from early PCH assessments.

Indicators of ASD and ADHD problems

In Chapter 4 we assessed whether early indicators of ASD and ADHD problems can be identified with early childhood findings as registered by PCH. In this chapter early indicators and ASD and ADHD problems were measured at different moments in time from pregnancy up to age 4 and between the age of 11 and 17 years, respectively. ASD and ADHD problems were based on the parent-reported Children's Social Behavior Questionnaire (CSBQ) and the Child Behavior Checklist (CBCL), respectively. Several early childhood indicators were identified that predicted ASD and ADHD problems. Male gender and the absence of parent-

reported positive behavior at toddler age were generic indicators, while a low birth weight, social behavioral problems, language, and psychomotor and eating problems at toddler age were specific indicators for ASD problems. Low level of education of the mother, maternal smoking during pregnancy, gross motor skills during infancy, and attention hyperactivity problems at toddler age were specific indicators for ADHD problems. In Chapter 4 we concluded that routine data on early childhood from PCH services are predictive for ASD and ADHD problems in adolescents in the general population. The PCH services are a useful setting to identify high risk groups, and to monitor them subsequently.

Indicators for a disputed social status

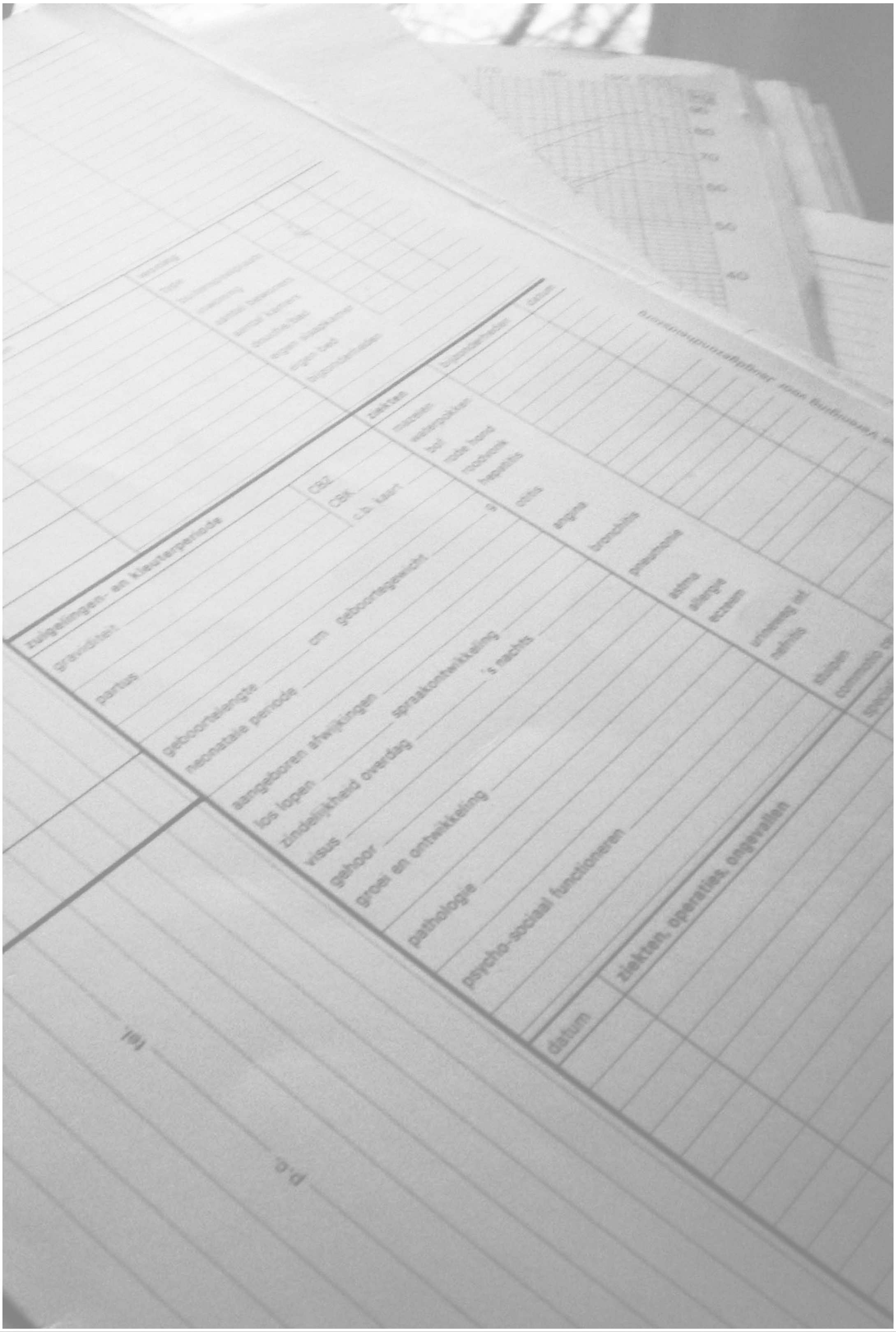
Children and adolescents with a disputed social status among peers are at risk for several problems including being bullied. However, evidence on the joint effects of early risk factors for a disputed social status is limited. Therefore, in Chapter 5 we described the prediction of which children (in preadolescence) have a heightened chance of being disliked or ignored by their peers based on data from the routine PCH. Early childhood indicators were measured at different moments, from pregnancy up to age 4. To assess social status, peer nominations were used at age 11. Findings show that several early childhood indicators were predictive for neglect and rejection by peers. Children with a low birth weight, early motor problems, early sleep problems, and children with parents with a low educational level were more likely to have a neglected status; children with early attention hyperactivity problems were less likely to be so. Boys, children with parents with a low educational level, and children with externalizing problems in toddlerhood were more likely to have a rejected status in preadolescence. We concluded that PCH findings on early childhood – on motor and social development – are predictive of a neglected and rejected status in preadolescence. PCH can be a good setting to monitor social status of preadolescents.

Validity of parental recall

The study described in Chapter 6 investigated the validity of parental recall on pregnancy, birth and early childhood behavior at child age 11. Evidence on the validity of parental recall of early childhood behavior is lacking. Findings show a poor parental recall after a 10-12 year period for maternal alcohol use during pregnancy and early childhood behavior, which was mostly due to over-reporting at age 10-12. In contrast, the recall of maternal smoking during pregnancy was good. For birth weight and gestational age, no systematic difference between recalled and PCH-registered data were found. It was concluded that retrospectively collected information on maternal alcohol use during pregnancy and early childhood behavior is sometimes biased, which limits its value in estimating the contribution of early life adversity to health in later life. But the reliability of recalled (TRAILS) data on maternal smoking during pregnancy, birth weight and gestational age was good.

Discussion and implications

In Chapter 7 the answers on the main research questions of this thesis were summarized. The results were discussed, methodological considerations and recommendations were made, both for PCH practice and research. The results of this thesis show that early findings of PCH professionals predict psychosocial problems in (pre)adolescence, but only to a moderate degree. Externalizing, ASD and ADHD problems can be better predicted with early PCH data than internalizing problems. Although several predictors were identified which may facilitate the PCH professionals in their work, our results show the difficulty of accurate prediction of psychosocial problems from early PCH findings. More research is needed to further improve the long-term predictive value and robustness of early PCH findings, so that it can be better used by PCH professionals in the care they provide to children and adolescents.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Samenvatting

Dit proefschrift richt zich op het voorspellen van psychosociale problemen – dat wil zeggen emotionele, gedrags-, aandachtstekort / hyperactiviteit en autisme spectrum problemen – bij adolescenten op basis van gegevens over de vroege ontwikkeling zoals vastgelegd door professionals van de Jeugdgezondheidszorg (JGZ). Tevens wordt onderzocht welke indicatoren uit de vroege kindertijd voorspellend zijn voor de sociale status in de preadolescentie en worden de validiteit en nauwkeurigheid vastgesteld van de gegevens die ouders zich herinneren over de leefstijl van de moeder tijdens de zwangerschap, geboortekenmerken en gedrag in de vroege kindertijd. Het in dit proefschrift beschreven onderzoek maakt deel uit van TRacking Adolescents' Individual Lives Survey (TRAILS), een grootschalig prospectief onderzoek onder de algemene bevolking naar determinanten van geestelijke gezondheid en sociale ontwikkeling tijdens de adolescentie en jongvolwassenheid. Met steun van de instellingen voor JGZ in Drenthe, Friesland en Groningen waren we in staat de benodigde gegevens te verzamelen uit JGZ-dossiers in hun archieven.

Inleiding

In hoofdstuk 1 wordt beschreven wat psychosociale problemen zijn en hoe complex de vroegtijdige onderkenning van deze problemen is. De JGZ biedt een ideale setting voor de vroegtijdige onderkenning van psychosociale problemen. Aan het eind van dit hoofdstuk worden het doel van dit onderzoek en de onderzoeksvragen geformuleerd, de TRAILS-studie en de dataverzameling uit de JGZ-dossiers worden beschreven.

De onderzoeksvragen zijn:

1. Kunnen we op basis van gegevens uit de vroege kindertijd, geregistreerd door de JGZ, voorspellen welke preadolescenten een verhoogd risico lopen op het ontwikkelen van psychosociale problemen?
2. Welke vroege risicofactoren, vastgelegd door JGZ-professionals, voorspellen internaliserende en externaliserende probleemtrajecten bij adolescenten?
3. Kunnen we vroege indicatoren identificeren van autisme spectrum (AS) en aandachtstekort / hyperactiviteit (ADH) problemen met gegevens uit de vroege kindertijd geregistreerd door de JGZ?
4. Kunnen we voorspellen welke kinderen een verhoogde kans lopen om afgewezen of genegeerd te worden door hun preadolescente leeftijdgenoten op basis van JGZ-gegevens uit de vroege kindertijd?
5. Hoe valide is dat wat ouders zich herinneren over zwangerschap, geboorte en gedrag uit de vroege kindertijd van hun kind in de leeftijd van 10 tot 12 jaar?

Indicatoren van psychosociale problemen

In hoofdstuk 2 beschrijven we de ontwikkeling en validering – in twee datasets – van een predictie model voor psychosociale problemen in de preadolescentie gebaseerd op reguliere JGZ-gegevens over de ontwikkeling in de vroege kindertijd. Gegevens over de vroege kindertijd werden vastgelegd tijdens de zwangerschap en op vierjarige leeftijd, psychosociale problemen werden gemeten op elfjarige leeftijd met behulp van rapportage door de ouders (met de Child Behavior Checklist, CBCL).

Door de JGZ geregistreerde gedragsproblemen, aandachtstekort / hyperactiviteit problemen, enuresis (incontinentie voor urine), opleidingsniveau van vader, en geslacht (man) voorspelden externaliserende problemen. Internaliserende problemen werden voorspeld door roken van de moeder tijdens de zwangerschap, slaapproblemen op vroege leeftijd en geslacht (man). Opmerkelijk is dat het ontbreken van informatie in het dossier voorspellend was voor psychosociale problemen op de leeftijd van 10-12 jaar.

Het model voor externaliserende problemen heeft een matig onderscheidend vermogen (AUC 0,66; 95% betrouwbaarheidsinterval 0,59-0,72). Dit betekent dat voor 66% van de kinderen met externaliserende problemen de voorspelling correct was met door de JGZ geregistreerde gegevens over de vroege ontwikkeling. Echter, voor internaliserende problemen was de AUC 0,54 (95% betrouwbaarheidsinterval 0,47-0,60), dit betekent een onvoldoende onderscheidend vermogen.

De conclusie is dat externaliserende problemen in de preadolescentie matig voorspeld worden door de JGZ geregistreerde gegevens over de vroege ontwikkeling en internaliserende problemen slecht voorspeld worden.

Trajecten van psychosociale problemen

In hoofdstuk 3 wordt beschreven welke vroege risicofactoren, vastgesteld door JGZ-professionals, trajecten van internaliserende en externaliserende problemen bij adolescenten voorspellen. Anders dan in hoofdstuk 2, werden indicatoren uit de vroege kindertijd (waar van toepassing) en uitkomstmaten gemeten op verschillende momenten in de tijd: achtereenvolgens van zwangerschap tot vierjarige leeftijd en tussen de leeftijd van 11 en 17 jaar. Informatie over vroege indicatoren kwam uit de dossiers van de JGZ. Trajecten van internaliserende en externaliserende problemen werden gebaseerd op een combinatie van gegevens: de door ouders ingevulde CBCL vragenlijst en door adolescenten ingevulde Youth Self Report (YSR) vragenlijst.

Vier typen trajecten werden geïdentificeerd, voor elk van beide geslachten en voor elk van beide typen problemen. Per trajecttype werd zowel een hoog traject van adolescenten met klinische problemen, als een middelhoog, middellaag en laag traject geïdentificeerd. Alle trajecten waren relatief stabiel over leeftijd; de continuïteit van deze problemen was erg hoog. Beperkte sets van indicatoren (uit de vroege kindertijd) van JGZ-gegevens voorspelden elk van deze trajecten. Alle sets bevatten voor beide geslachten de volgende indicatoren:

lage en gemiddelde opleidingsniveaus van de ouders, gescheiden ouders en eenoudergezinnen vanwege andere redenen. Voor trajecten van internaliserende problemen waren slaapproblemen een extra voorspeller voor jongens, voor meisjes waren dit taalproblemen. Trajecten van externaliserende problemen werden voor beide geslachten bovendien voorspeld door roken van de moeder tijdens de zwangerschap. Tevens waren voor jongens vroege gedragsproblemen en aandachtstekort / hyperactiviteit problemen voorspellend.

De conclusie is dan ook dat trajecten van internaliserende en externaliserende problemen tijdens de adolescentie opmerkelijk stabiel zijn en voorspeld kunnen worden door een beperkte set van JGZ-gegevens over de vroege ontwikkeling.

Indicatoren van AS en ADH problemen

In hoofdstuk 4 stellen we vast welke vroege indicatoren van autisme spectrum en aandachtstekort / hyperactiviteit problemen geïdentificeerd kunnen worden op basis van JGZ-gegevens uit de vroege kindertijd. Vroege indicatoren en AS en ADH problemen zijn op verschillende momenten in de tijd gemeten: achtereenvolgens van zwangerschap tot vierjarige leeftijd en tussen 11 en 17 jaar. AS en ADH problemen werden gemeten met respectievelijk de door ouders ingevulde Children's Social Behavior Questionnaire (CSBQ) en de CBCL vragenlijst.

Verschillende indicatoren voor AS en ADH problemen in de adolescentie werden geïdentificeerd. Geslacht (man) en de afwezigheid van door ouders gerapporteerd positief gedrag op vroege leeftijd waren voorspellers voor beide typen problemen. Een laag geboortegewicht, afwijkend sociaal gedrag, taalproblemen, problemen met eten en psychomotorische problemen op vroege leeftijd waren specifieke indicatoren voor AS problemen. Een laag opleidingsniveau van de moeder, roken tijdens de zwangerschap door de moeder, vertraagde ontwikkeling van de grove motoriek en aandachtstekort / hyperactiviteit problemen op vroege leeftijd waren specifieke indicatoren voor ADH problemen.

De conclusie is dat reguliere JGZ-gegevens over de vroege ontwikkeling voorspellende waarde hebben voor AS en ADH problemen voor adolescenten in de algemene populatie. Instellingen voor JGZ zijn een geschikte setting om hoogrisicogroepen te identificeren, en deze vervolgens te monitoren.

Indicatoren voor een lage sociale status

Kinderen en adolescenten met een lage sociale status onder leeftijdgenoten lopen het risico verschillende problemen te krijgen, waaronder gepest worden. Het wetenschappelijk bewijs voor de gezamenlijke effecten van vroege risicofactoren op een lage sociale status is echter beperkt. Daarom proberen we in hoofdstuk 5 te voorspellen welke kinderen in de preadolescentie een verhoogde kans lopen om afgewezen of genegeerd te worden door

leeftijdgenoten op basis van regulier door de JGZ verzamelde gegevens over de vroege ontwikkeling. Indicatoren (uit de vroege kindertijd) werden op verschillende momenten gemeten, van de zwangerschap tot vierjarige leeftijd. Sociale status op elfjarige leeftijd werd vastgesteld op basis van beoordelingen van leeftijdgenoten.

De resultaten wijzen uit dat verschillende vroege indicatoren voorspellen of een kind in de preadolescentie wordt genegeerd of afgewezen door leeftijdgenoten. Kinderen met een laag geboortegewicht, problemen als jong kind met de motoriek of met slapen, en kinderen met laagopgeleide ouders liepen meer kans om als preadolescent genegeerd te worden; kinderen met vroege aandachtstekort / hyperactiviteit problemen liepen hierop minder kans. Jongens, kinderen van laagopgeleide ouders, en kinderen met externaliserende problemen in de vroege kindertijd liepen meer kans om te worden afgewezen als preadolescent.

De conclusie is dat JGZ-gegevens over de vroege - motorische en sociale - ontwikkeling de sociale status (negeren en afwijzing door leeftijdgenoten) in de preadolescentie voorspellen. De JGZ kan een goede setting zijn om problemen met de toekomstige sociale status te monitoren.

De validiteit van herinneringen van de ouders

In de studie beschreven in hoofdstuk 6 onderzochten we de validiteit van herinneringen van de ouders aan de zwangerschap, geboorte en gedrag (op leeftijd 4-6) van hun elfjarige kind. Wetenschappelijke kennis over de validiteit van herinneringen van ouders van gedrag uit de vroege kindertijd is er nog niet.

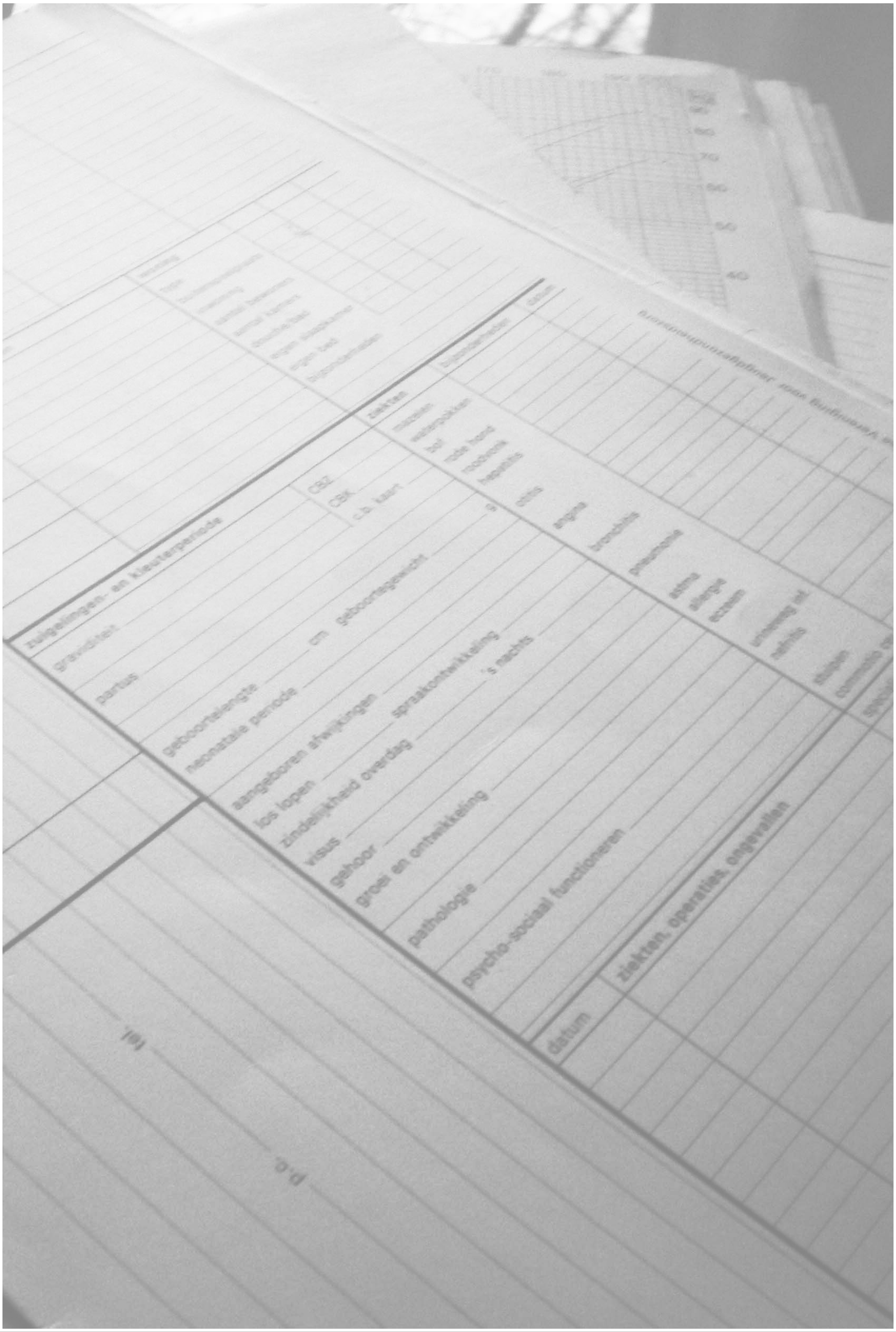
De resultaten wijzen erop dat ouders zich na een periode van 10 tot 12 jaar slecht kunnen herinneren hoe het gesteld was met alcoholgebruik tijdens de zwangerschap en gedrag uit de vroege kindertijd; er bleek vooral sprake van overrapportage op 10 tot 12-jarige leeftijd van hun kind. Daarentegen herinnerden zij zich goed of er gerookt werd tijdens de zwangerschap. Voor geboortegewicht en zwangerschapsleeftijd werden geen systematische verschillen gevonden tussen wat ouders zich herinnerden en wat de JGZ registreerde.

De conclusie is dat retrospectief verzamelde informatie over alcoholgebruik tijdens de zwangerschap en gedrag (op leeftijd 4-6) soms vertekend is, wat de waarde ervan voor het bepalen van de bijdrage van moeilijkheden en problemen (tijdens de kleuterschoolperiode) aan de gezondheid op latere leeftijd beperkt. Daarentegen bleek dat wat ouders zich herinnerden (TRAILS data) van roken tijdens de zwangerschap, geboortegewicht en zwangerschapsleeftijd wel betrouwbaar is.

Discussie en implicaties

In hoofdstuk 7 worden de antwoorden op de eerdergenoemde onderzoeksvragen van dit proefschrift samengevat. De resultaten worden in de context gezet van eerder onderzoek en methodologie en er worden aanbevelingen geformuleerd, zowel voor de praktijk van de Jeugdgezondheidszorg als voor het wetenschappelijk onderzoek.

De resultaten van dit proefschrift wijzen uit dat vroege bevindingen van JGZ-professionals psychosociale problemen in de (pre)adolescentie voorspellen, maar slechts in beperkte mate. Externaliserende problemen, AS en ADH problemen kunnen beter worden voorspeld op basis van door JZG geregistreerde gegevens dan internaliserende problemen. Hoewel verschillende voorspellers werden geïdentificeerd die het werk van JGZ-professionals kunnen ondersteunen, wijzen onze resultaten uit hoe moeilijk het is psychosociale problemen op latere leeftijd nauwkeurig te voorspellen op basis van door de JGZ geregistreerde gegevens over de vroege ontwikkeling. Meer onderzoek is nodig om de over langere termijn voorspellende waarde en kracht van JGZ-gegevens over de vroege ontwikkeling te verbeteren om JGZ-professionals in hun zorg aan kinderen en adolescenten beter te kunnen ondersteunen.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Dankwoord

Graag wil ik een aantal mensen bedanken voor hun bijdrage aan de totstandkoming van dit proefschrift en aan de mooie tijd als promovendus. Zonder hen zou het niet hetzelfde zijn geweest.

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Lieve Jelle, mijn kleine broertje dat al lang niet meer klein is. Qua leeftijd lag je net een jaar voor op de TRAILS deelnemers. Ook al ben ik vaak het mikpunt van je grappen, toch geniet ik met volle teugen van je humor. Ik ben heel trots dat je mijn paranimf bent. Word jij de volgende dr. Jaspers?

Lieve Karim:

حبيبي. حياتي معك هي أكثر من ذلك بكثير ملونة. شكرا لدعمك وحبك غير المشروط. لا استطيع الانتظار لبقية حياتنا.

Nu wordt het tijd om Arabisch te leren…

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